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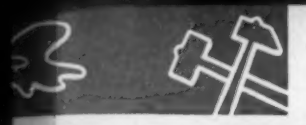

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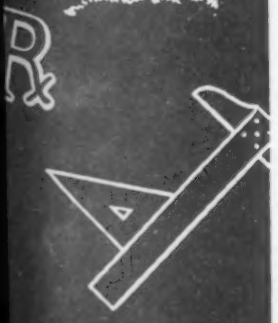

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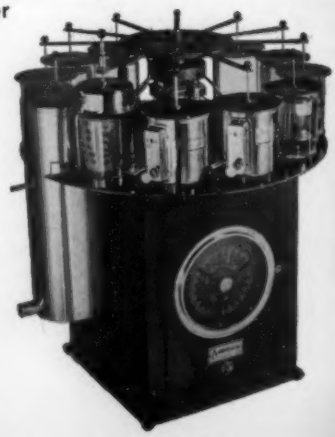

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Geographical Research

RECENT progress in geographical research has been marked by a definite trend into fields of specialization. To maintain a proper perspective of the whole science, these special fields should be accorded respect and encouragement, but should not be accepted as separate sciences. In the past few decades, as a result of superior communications and increased human contacts, more exploration and greater research contributing to the understanding of human relationships have not only been warranted but demanded.

Medical geography, the geography of disease, is an expression of this fact. Medical geography is based on well-known facts widely scattered through the various branches of medicine; what may be new is the approach by definition and methods to the problems raised. Recognizing that geographical factors determine the occurrence and distribution of a pathological complex and that disease is a multiple phenomenon which occurs only if various factors coincide in time and space, the American Geographical Society has undertaken to give as much weight as possible to medical geography.

The resultant development has been the study of disease as it is related to physical environment in two principal ways—when it occurs as a result of parasitic infection and when it occurs as a result of influence of the milieu on physiological functions—thus perhaps relating degenerative diseases to the geographical environment. To this end an "Atlas of Diseases" is being compiled, a continuing project of mapping the world distribution of diseases. It is based on all available published and unpublished data, showing their significant epidemiological factors and geographical distribution, with a summary of the more important epidemiological problems relating to each disease. Two maps, showing the world distribution of cholera and of poliomyelitis, have already been published, with a score or more to follow.

Another expression of recent progress has been a burgeoning of explorations likely to result in valuable discoveries in geography and its related sciences. Military necessity has been a strong stimulus, although not necessarily a primary one; the immediate objective has been to learn the influence of environmental factors upon man and upon their interrelated future.

During the past quarter of a century it has been proved that there has been a definite amelioration of climate. Hans W:son Ahlmann, Swedish ambassador to Norway and one of the world's foremost glacio-meteorologists, says this climatic change is the first in the endless series of climatic variations and fluctuations in the past and coming history of the earth. He points out that it can be studied, measured, and possibly explained through systematic and comprehensive studies in glaciology.

Detailed investigations, cosponsored by federal agencies and the American Geographical Society are now being carried on in the ice fields of southeastern Alaska. The Juneau Ice Field Research Project is an effort to unravel the remaining secrets of glacier ice and to determine the ways in which it indicates even minor changes in climate.

The project has particular significance: Equipment, supplies of all kinds, and new logistic methods are being tested, and effective operating techniques are being extended and improved. The small research station, on a rock island on the edge of the Taku Glacier 16 miles above its terminus, is a good operating base for such studies. The AGS hopes other individuals and institutions working in the varied scientific problems that may be investigated in this area, will make use of these facilities. Such studies are a matter of scientific teamwork, and the experience in Alaska is expected to encourage future cooperative effort among the various disciplines involved.

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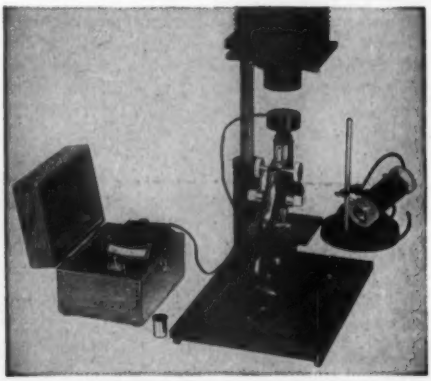

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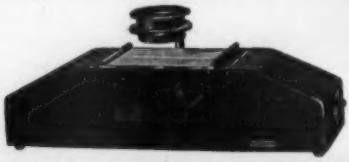

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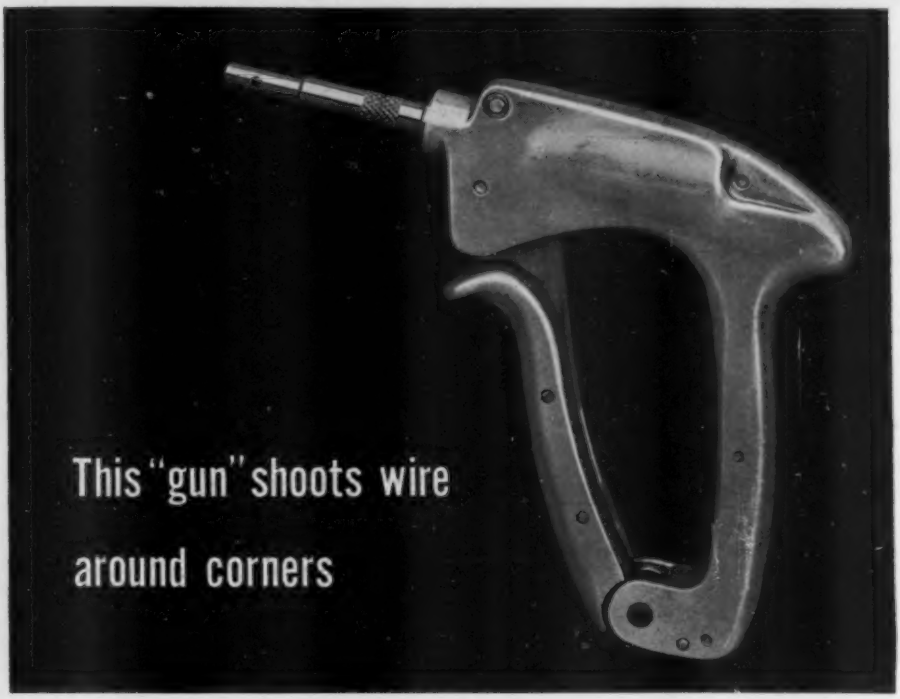

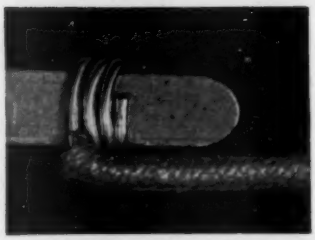

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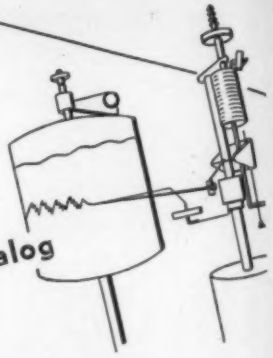

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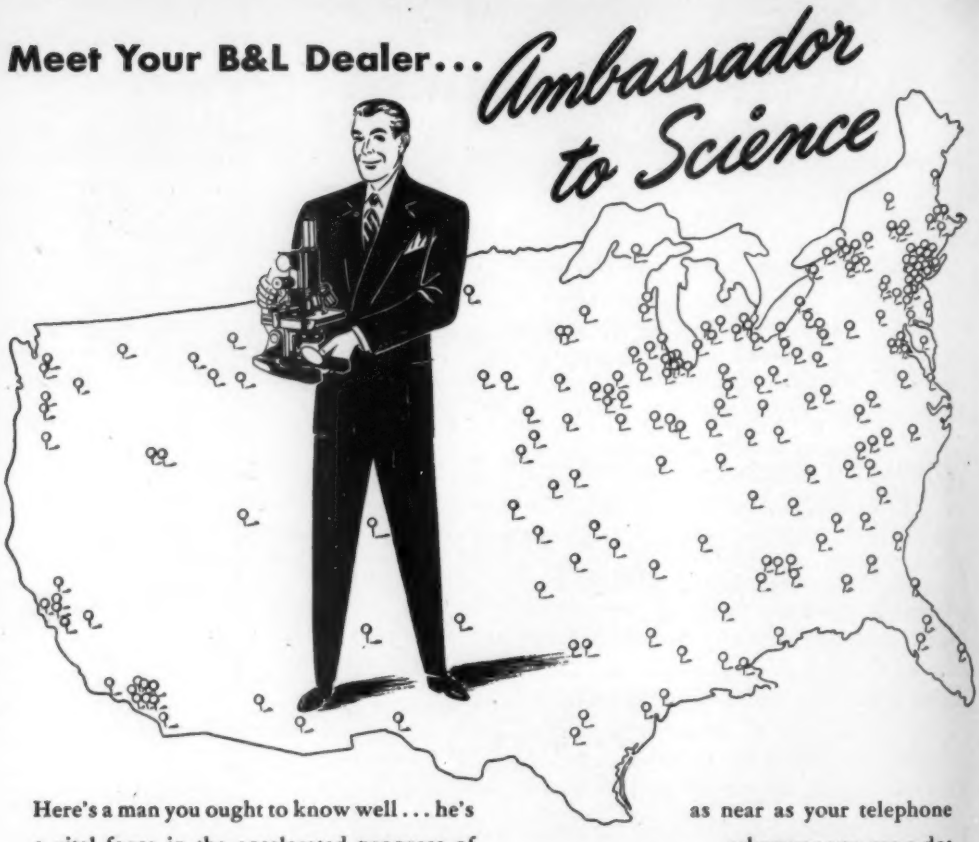

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Ferroelectricity

Bernd T. Matthias[1]

Bell Telephone Laboratories, Murray Hill, New Jersey

UNDER THE NAME OF FERROELECTRICS one classifies those materials which exhibit dielectric anomalies phenomenologically similar to the magnetic behavior of the ferromagnetics. Perhaps it would have been more logical to use the term Rochelle electrics, thus emphasizing the similarity in the dielectric behavior to that of Rochelle salt, for which this behavior was first discovered by J. Valasek (*1*).

In this discussion the known ferroelectrics will be listed, and the various theories that have been created to explain them will be examined.

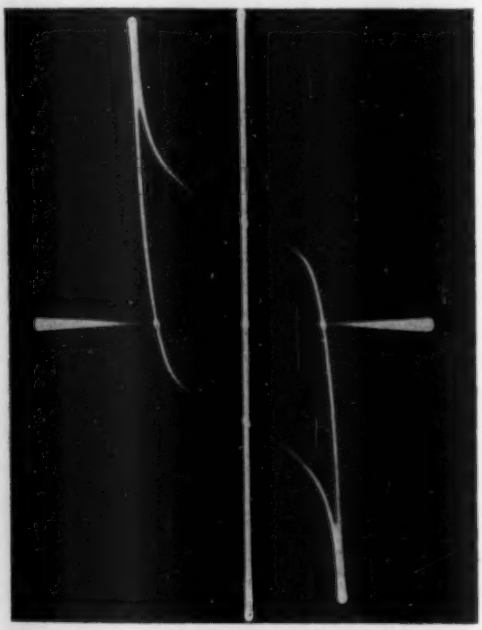


FIG. 1. Hysteresis between dielectric field and polarization.

Rochelle salt, the potassium sodium tartrate, was the first crystal to be shown to haxe extremely high dielectric constants—of the order of 10^3. This, however, is confined to the temperature interval between −18° C and +24° C and to one crystallographic direction, parallel to the *a*-axis. In analogy to ferromagnetism, the two temperatures above and below which the ferroelectric behavior disappears are called the two Curie points of Rochelle salt. Simultaneously with the change in the dielectric constant, the piezoelectric constant d_{14} goes through very high values. In the ferroelectric range a hysteresis loop between electric field and polarization is observed, indicating the existence of a spontaneous polarization. Outside the ferroelectric range the dielectric constant decreases and the spontaneous polarization disappears. (Figs. 1, 2.)

Until now none of the crystals isomorphous with Rochelle salt had shown any similar dielectric anomalies. The only changes which did not drastically alter the ferroelectric activity of Rochelle salt were a partial substitution of hydrogen by deuterium, and hydrostatic pressure. These result in a spreading of the ferroelectric range. Otherwise hardly anything else could be done to the salt which would not destroy the ferroelectric properties. If only a small percentage of potassium is replaced by rubidium, ammonium, or thallium, for example, the dielectric anomalies disappear entirely.

Only recently (*2*) it was noticed that Scholz's (*3*) measurements on $LiNH_4C_4H_4O_6 \cdot H_2O$ at temperatures above 125° K show a steep rise in certain piezoelectric moduli for this crystal with decreasing temperature, a reasonable extrapolation indicating that the piezo-moduli become infinitely large in the neighborhood of 100° K. This behavior leads us to expect the occurrence of ferroelectricity in lithium ammonium tartrate at low temperatures, a hypothesis that has now been confirmed by experiment (*2*).

Fig. 3 shows the temperature variation of ε_b, the plate with the electric field parallel to the *b*-axis of the crystal. The sharp peak at 98.5° K marks an upper Curie point, below which the crystal becomes ferroelectric. Polarization versus electric field exhibits the well-known hysteresis loop, though the average value

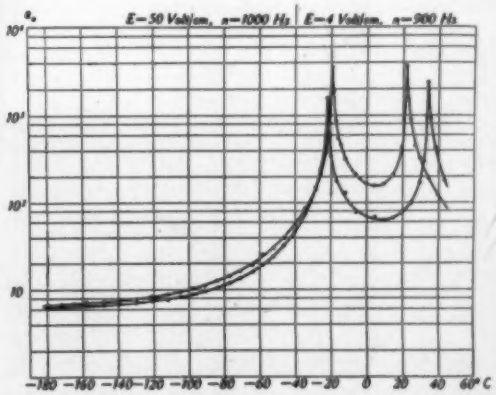


FIG. 2. Dielectric constant of Rochelle salt (*17*).

[1] On leave of absence at the University of Chicago.

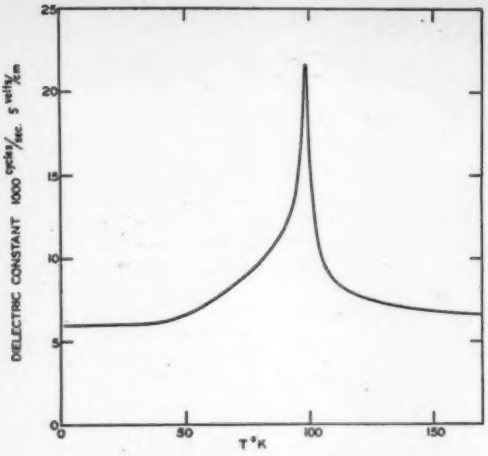


FIG. 3. Temperature variation of dielectric constant Li $NH_4C_4H_4O_6 \cdot H_2O$.

of the dielectric constant is low compared to average values for other ferroelectric crystals, including Rochelle salt. The absence of a lower Curie point may be inferred from the monotonic variation of ε_b from the upper Curie point down to 1.3° K, the lowest temperature of measurement.

The above discovery immediately raised the question as to whether a similar type of ferroelectric behavior might occur in other isomorphous crystals, or whether lithium ammonium tartrate would turn out to be another singular case like Rochelle salt. Although the only other isomorphous crystal studied by Scholz (*3*), $LiKC_4H_4O_6 \cdot H_2O$, gave no marked variation of

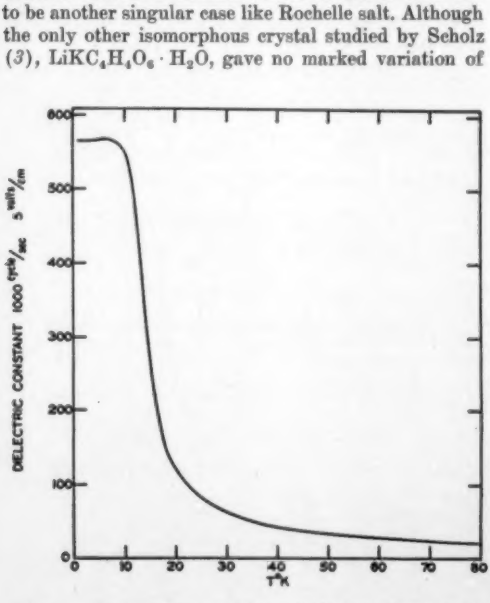


FIG. 4. Temperature variation of dielectric constant Li $TlC_4H_4O_6 \cdot H_2O$.

piezo-moduli with temperature, this did not seem unreasonable in view of the difference between the K^+ and NH_4^+ ions. It is obvious that ferroelectricity will be *less* disturbed in the replacement of NH_4^+ by the more nearly isosteric Rb^+ or Tl^+ ions.

Fig. 4 shows the temperature variation of the dielectric constant, ε_a, of a crystal of $LiTlC_4H_4O_6 \cdot H_2O$ with the electric field applied parallel to the *a*-axis.

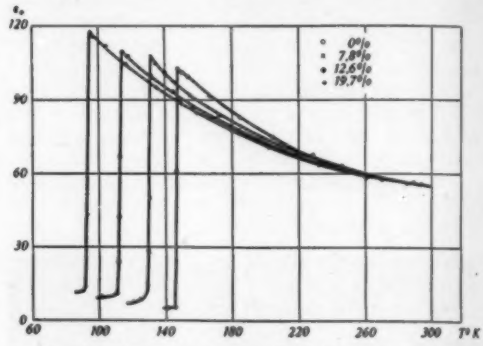


FIG. 5. Shift of the transition point of $(NH_4, Tl)\ H_2PO_4$ with varying Tl-content (*5*).

With decreasing temperature ε_a showed an unusually rapid rise between liquid hydrogen and liquid helium temperatures, but for a given field strength eventually passed through a very flat maximum and tended to a steady value as absolute zero was approached. At

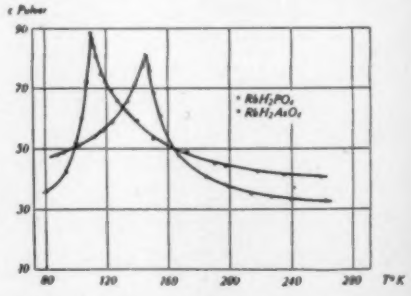


FIG. 6. Dielectric constant RbH_2PO_4 and RbH_2AsO_4 powder (*6*).

liquid helium temperature, however, ε_a was extremely sensitive to small changes in field strength owing to the fact that *below* 10 (±1)° K the crystal exhibited, as expected, a ferroelectric hysteresis loop.

In 1935 two other ferroelectric crystals were discovered by Busch and Scherrer (*4*). They were the tetragonal potassium dihydrogen phosphate and the corresponding arsenate, KH_2PO_4 and KH_2AsO_4. Only one Curie point was observed, the temperature below which the crystals became and remained ferroelectric. In the case of the corresponding ammonium salts, as the temperature is lowered an ammonium transition intervenes and a ferroelectric condition does not occur

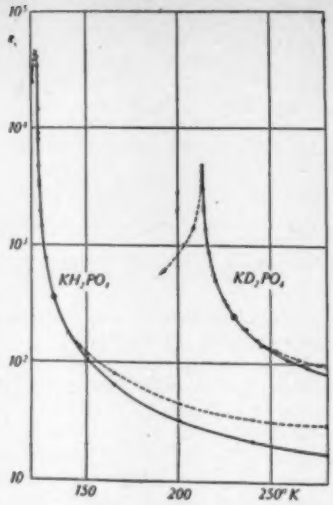


FIG. 7. Dielectric constant of normal and heavy potassium phosphate (*21*).

(*5*). The ammonium transition is due to the quadrupole moment interaction of the NH_4 groups.

Their ordered arrangement below the transition temperature modifies the internal field to an extent which prevents the final occurrence of ferroelectricity. Screening the NH_4 ions by spherical symmetric thallium ions weakens the interaction and therefore lowers the transition temperature (Fig. 5). But it was possible to show later that all other crystals, isomorphous to the K-salt at room temperatures, such as the rubidium salts (*6*), do also become ferroelectric. If hydrogen is replaced by deuterium in KH_2PO_4 the Curie point is shifted to considerably higher temperatures (Figs. *6*, *7*).

The next ferroelectric crystal to be discovered was $BaTiO_3$. This was found more or less simultaneously in the United States, England, and Russia, after titanate ceramics with high dielectric constants had been investigated for the preceding 15 years. Single crystals of the compound were first grown in Zurich (*7*). Again there was only one Curie point, and it could be shifted to higher or lower temperatures by partially replacing the Ba ions with lead or strontium. However, it was then not possible to detect ferroelectricity in any other of the isomorphous titanates. In these earlier stages of investigation it was therefore not yet quite clear whether barium titanate was again an isolated case like Rochelle salt.

In 1949, in following up a hypothesis which will be discussed in detail later, several new ferroelectric crystals isomorphous to barium titanate were discovered, in the alkali niobates and tantalates (*8*). As the assumptions made were almost independent of the crystal structure, two new ferroelectric crystal classes were found subsequently in the ilmenite (*9*) and the ReO_3 (*10*) structures. The crystals in the first system were lithium niobate and tantalate, and in the latter tungsten trioxide.

Theoretical aspects: Rochelle salt. Many theories have been advanced in attempts to account for the ferroelectricity of Rochelle salt, the phosphates, and barium titanate. In addition, several review articles have recently appeared which deal with these materials (*11*, *12*).

Rochelle salt, though the first to be discovered (some 70 years ago), is still the hardest to explain. Early theories about rotating dipoles have long been forgotten. Today a possible way seems to be Ubbelhode's application (*13*) of Huggins treatment of the free hydrogen bond (*14*). This bond presumably changes from a one- to a two-well potential if the bond length exceeds 2.59 A. This is just about the length of the hydrogen bond in Rochelle salt (*15*). This fact can explain only the lower Curie point, however. Even from a phenomenological point of view it is difficult to account for the *two* Curie points.

Mueller's interaction theory (*16*), however, should be mentioned with respect to a phenomenological explanation of both Curie points. He arrives at the conclusion that *two* Curie points occur as a result of the electromechanical interaction. If the corresponding properties of a completely clamped crystal could be measured, then the dielectric susceptibility should show *one* maximum only near 5° C. No experimental verification could as yet be obtained.

The small change in ferroelectric properties with the replacement of hydrogen by deuterium (*17*) certainly does not stress the importance of the hydrogen bond. It looks much more as if Rochelle salt is merely an accident of nature which happens to fall upon a stoichiometrically well-defined compound. Sufficiently outside the small range of temperature or crystallographic dimensions no anomalies can be observed.

In comparing the recently discovered ferroelectric tartrates with Rochelle salt, it has to be borne in mind that, although the crystal symmetry is the same in each case, the axial ratios are quite different, and in addition Rochelle salt has *four* molecules of water of crystallization compared to *one* molecule in both of the new crystals. In view of this fact, it is somewhat surprising that practically the same value of spontaneous polarization is observed for each crystal, which may indicate again that the water molecules play a relatively unimportant role in the ferroelectric behavior. The low value of the dielectric constant and unusual (*b*) direction of ferroelectric behavior in lithium ammonium tartrate are possibly the result of an interaction between ammonium ions of the type observed in $NH_4H_2PO_4$ (*5*). The new results strengthen the assumption that the lower Curie point in Rochelle salt is somewhat accidental. A comparison of the lithium thallium tartrate data with those for potassium tantalate (*8*) seems to indicate that sharp dielectric constant peaks do not occur near absolute zero, presumably because of an increase of time of alignment.

The dihydrogen phosphates. The tetragonal dihydrogen phosphates and arsenates have permitted more insight. Comparison of the isomorphous crystals shows the tetragonal H_2PO_4 lattice to be ferroelectric in general. The PO_4 tetrahedra are linked one to another by hydrogen bonds. The statistical theory of the position of these hydrogens was carried out by Slater (*19*) in a well-known paper. As the hydrogen bond is nearly perpendicular to the direction of the spontaneous polarization parallel to the *c*-axis (*20*), this polarization seems to be created rather by the induced moment in the PO_4 groups than by the moment of the hydrogen bond itself. Replacing the hydrogen by deuterium, the Curie point of KH_2PO_4 is shifted to higher temperatures (*21*). This is excellent confirmation of the essential role of the hydrogen bond as the cause of ferroelectricity in this case. The zero point energy of the deuterium is about 1.4 times smaller than that of the hydrogen, and a larger thermal energy is therefore required to destroy the ordered state (*22*).

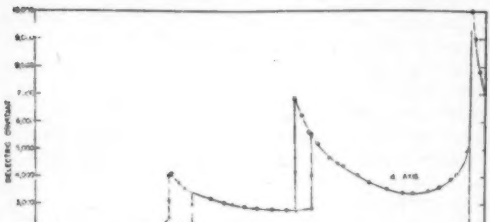


FIG. 8. Dielectric constant of barium titanate (Merz, W. *Phys. Rev.*, **76**, 1221 [1949]).

Order-disorder and displacive transitions. This brings us to the differences in ferroelectric transitions first pointed out by Tisza (*23*). In Rochelle salt outside the ferroelectric region there seems to be no ordered state, at either high or low temperatures, which has to be overcome by the thermal motion. We have here a displacive transformation, whereas the transition in KH_2PO_4 is an order-disorder phenomenon.

According to Tisza, no dipoles are present in Rochelle salt outside its ferroelectric region, whereas they continue to exist in KH_2PO_4 above the Curie point in a disordered arrangement. This point of view has been strengthened by the small anomalies of the specific heat in the case of displacive transformations.

For barium titanate the small anomaly of the specific heat at the Curie point again indicated clearly a displacive transformation like the one in Rochelle salt. The atomic mechanism is, however, quite different. TiO_2 and several metatitanates all have very high dielectric constants, ranging up to 400. The same mechanism in barium titanate causes a dielectric constant which is so large as to produce a spontaneous

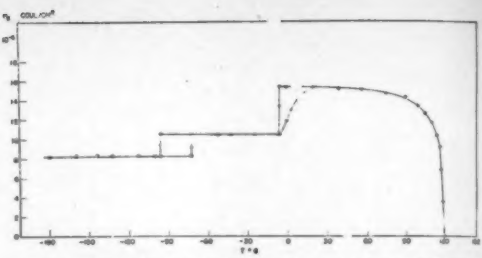


FIG. 9. Spontaneous polarization of a $BaTiO_3$ single domain crystal (Merz, W. *Phys. Rev.*, **76**, 459 [1949]).

polarization below a certain critical temperature, the Curie point (Figs. *8, 9*).

In the case of barium titanate, fortunately, the structure is well known, and no ambiguities exist such as the positions of hydrogens. The crystal structure is that of perovskite, the unit cell of which is a cube in the idealized case (Fig. 10). The Ba-ions occupy cube corners, the oxygens face centers, and the titanium is in the cube center. One of the first explanations was the "rattling" theory, which originated in England and which assumed the motion of the titanium ion within a too large oxygen octahedron (*24*). The order of magnitude for the amplitude of the titanium can be evaluated from the saturation polarization. Considerations of the ionic radii, as well as x-ray investigation, finally spoke against this assumption.

A different approach was that of Jonkers and van Santen (*25*). According to these investigators, $BaTiO_3$ is one of the few cases in which the polarizability per unit volume increases to the limit where a spontaneous polarization will occur. This is easily seen in Clausius-Mosotti's formula for the dielectric constant:

$$\frac{\varepsilon - 1}{\varepsilon + 2} = \frac{4\pi}{3} N\Sigma\alpha_{EL} + \alpha_{ion} + \frac{\mu^2}{3KT} \qquad (1)$$

The summation extends over ionic as well as electronic polarizabilities of the simple oxides which are the constituents of the whole compound. $BaO + TiO_2$ now give a value which brings the right-hand side of equation (1) close to unity, thus giving an infinite dielectric constant. Doubts have been raised as to the validity of this partial summation, which in itself, furthermore, only reduces the problem of double oxides to that of the single one. These theories, as well as the ones to be mentioned later (*26*), confirm barium titanate as a ferroelectric, but do not permit any predictions concerning the occurrence of ferroelectricity in other compounds or systems. A different approach was therefore tried at Bell Telephone Laboratories.

Prediction of new displacive ferroelectrics: perovskites. The dielectric constant of TiO_2, *as well as* those of all pseudo-cubic (perovskite) metatitanates, was unusually high. One had therefore to assume that it was primarily the Ti-O (titanium surrounded by 6 oxygens in form of an octahedron) octahedra which contributed to the high dielectric constant, and by some coincidence caused ferroelectricity in barium

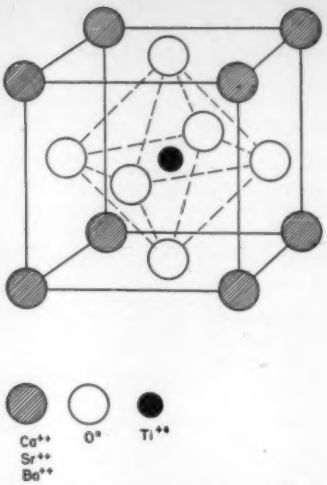


FIG. 10. Unit cell of the idealized perovskite structure.

titanate. The problem was therefore once again to account for the high dielectric constant of rutile, a matter that had already been attacked by Eucken and Beuchner as early as 1934 (*27*). As later shown by Slater (*26*) and by Jaynes and Wigner (*28*), it seemed reasonable to consider the octahedron as a *whole*, the high polarizability of oxygen being essential. It should therefore be possible to obtain the same high polarizabilities in other similar oxygen octahedra that had a central atom other than titanium; yet the corresponding stannates and zirconates gave comparatively low dielectric constants. Sn^{+4} did not have a noble gas configuration, however, and Zr^{+4} was much larger than Ti^{+4}. This viewpoint has been strengthened in two recent papers from Japan. Starting from the hypothesis for the critical size of the Ti-O octahedron, Nomura and Sawada (*29*) have repeated a coincidence similar to barium titanate by forming solid solutions of strontium and lead titanate which again were ferroelectric. On the other hand, reports on an anomaly of the dielectric constant in $PbZrO_3$ indicate quite a different behavior (*30*). No spontaneous polarization can be detected, and the large anomaly of the specific heat points to an order-disorder transformation. In order to obtain oxygen octahedra in which the oxygen to central atom distance was close to that in the $Ti\text{-}O_6$ octahedron, and in which the electron configuration of the central ion was that of a noble gas, one had to turn to the metaniobates and tantalates. They indeed proved to be ferroelectric (*8*) (Fig. 11). Since niobium and tantalum in the noble gas configuration are pentavalent, the valency of the big cation had to be reduced by one in order to restore electric neutrality. This leads to the alkali metaniobates and tantalates $KNbO_3$, $NaNbO_3$, $KTaO_3$ and $NaTaO_3$, all of which proved to be ferroelectric with Curie points between 13° K and 800° K (*18*).

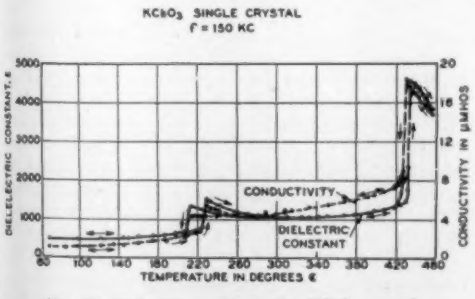
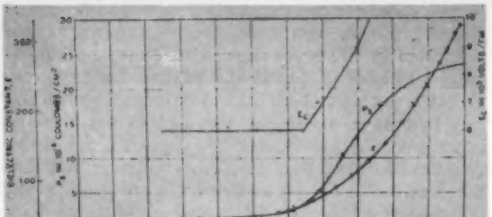


FIG. 11. Dielectric constant of a $KCbO_3$ crystal.

One step further in the direction of similar octahedra leads to tungsten trioxide (*10*), which again proved to be ferroelectric. Although the above-mentioned compounds are still isomorphous with barium titanate, WO_3 crystallizes in a somewhat different crystal structure, which is a pseudo-morph of ReO_3. This is a perovskite system in which the cube corners of the unit cell are omitted.

Ferroelectrics in the ilmenite system. It was important to realize that the hypothesis of the oxygen octahedra of critical size and electron configuration worked as well even in different crystal classes. Therefore compounds in the ilmenite system were considered next. So far, most theories, in order to prove their respective statements, made use of the fact that dielectric constants of double oxides, crystallizing in the rhombohedral ilmenite system, were very low compared to those in the perovskite system (*12, 25, 26*). These assumptions are quite erroneous, however. Single crystals of the hexagonal barium titanate already had shown dielectric constants up to 200 (*31*). In the perovskite system it had become obvious that the $Ti\text{-}O_6$ octahedra were less favorable for creation of ferroelectricity than the niobium or tantalum octahedra. We therefore began an investigation of corresponding compounds of the ilmenite system: $LiNbO_3$ and $LiTaO_3$. The dielectric constants measured in the beginning were quite low, between 15 and 30—that is, of the same order of magnitude as those reported for the other double oxides in the ilmenite system, measured on ceramics. Upon increasing the electric field strength it immediately became apparent that these crystals were very strongly polarized, and only the extremely high coercive field prevented the detection by bridge measurements (*9*). The hysteresis loop at 200° C—e.g., the dependence of the dielectric polarization upon the electric field—was a perfect rectangle. The value of the saturation polarization of $25 \cdot 10^{-6}$ Clb/cm² so measured was nearly twice that of the crystals in the perovskite system (Fig. 12). Ceramic samples of these compounds gave hardly any effect at all, however. This is understandable, considering the much lower symmetry of the ilmenite system as compared to the perovskite structure. It would therefore be necessary to investigate single crystals of the



Saturation values in a single crystal of $LiTaO_3$ as a function of temperature.

FIG. 12. Dielectric behavior of a $LiTaO_3$ crystal.

rhombohedral metatitanates before any conclusions as to their dielectric behavior could be reached.

We have tried to show that all metal-oxygen octahedra which fulfill certain conditions will always cause very high polarizabilities and are therefore the cause of ferroelectricity in those compounds that do not contain hydrogen. Other octahedra which do not satisfy the conditions may give rise to many different kinds of transitions, but never give high dielectric constants or ferroelectricity (*32*). The theoretical aspects concerning these octahedra have been and will be published by Jaynes and Wigner (*28*). The recent paper by Slater (*26*) on the correction of the Lorentz factor in barium titanate confines itself to this compound. Slater comes to the conclusion that the TiO strings running through the lattice are the essential factor for the occurrence of ferroelectricity.

Lower Curie point in $LiTaO_3$. Except for Rochelle salt, there never had been observed a lower Curie point—that is, a temperature *below* which the spontaneous polarization disappears completely. Only recently in $LiTaO_3$ a sharp decrease of the spontaneous polarization with decreasing temperature has been measured (*9*). A numerical treatment will be able to decide whether this is due to the stronger interaction between neighboring octahedra on account of their closer contact with each other. In the ilmenite structure neighboring octahedra share corners *and* edges, whereas in the perovskite system the octahedra only share corners.

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Technical Papers

The Mucopolysaccharides of the Ground Substance of Connective Tissue[1]

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The dramatic effects of cortisone and adrenocorticotrophic hormone (ACTH) on the manifestations of rheumatic diseases, as well as on some not classified as rheumatic, have forcefully reemphasized the importance of the connective tissues in the mechanism of a variety of disorders. It seems remarkable that we still know so little about the biochemistry and physiology of the mesenchyma, even though its contribution to biological processes and its paramount importance in pathology had been recognized long before the advent of cortisone.

In the past 20 years, the ground substance(s) of the mesenchyma have been studied extensively. The reawakened interest in these tissues was due in part to the isolation and characterization of some of the

[1] Supported in part by a grant from the Helen Hay Whitney Foundation. This paper was presented in part at the June 1950 meeting of the American Rheumatism Association.

component mucopolysaccharides of the ground substance(s) (*1*), and in part to the demonstration of the presence of enzymes in microorganisms and in mammalian tissues which hydrolyze some of these mucopolysaccharides, especially hyaluronic acid (*2*), and to the subsequent identification of these enzymes with the spreading agents (*3*).

The relative simplicity of our earlier concepts of the nature of the complexes presumed to be present in the ground substance(s) is no longer tenable and has had to be revised frequently on the basis of new experimental findings.

During the past few years we have been studying the distribution of the mucopolysaccharides in the skin, heart valves,[2] aorta, tendon,[2] synovial fluid, and umbilical cord. It was not possible with most of these tissues to utilize extraction with neutral salts; such methods do not extract mucopolysaccharide from tendon, aorta, or heart valves. Half-saturated lime water, which has been used extensively in earlier biochemical studies (*4*), and is still used in histological techniques, yields mucopolysaccharides bound to protein in denatured form—i.e., denatured acid mucoids (for nomenclature see [*5*]). We therefore resorted to extraction with 0.33–0.5 *N* NaOH, which hydrolyzes the bonds between carbohydrate and protein. The tissues were extracted at 0°, the extracts then being neutralized with acetic acid. The mucopolysaccharides solubilized by this method were freed of accompanying protein by treatment with amyl alcohol–chloroform, adsorption on Lloyd's reagent, or zinc hydroxide. Glycogen, which is always present in the extracts, was removed by digestion with a commercial amylase. The remaining high molecular polysaccharides were fractionally precipitated from calcium acetate–acetic acid solution by alcohol at 0°. These purification procedures were repeated when the fractions were found to be still contaminated. The fractions were analyzed for nitrogen, hexosamine, uronic acid, and sulfate, and the optical rotation was determined. The hydrolysis of the substances was determined by measuring the increase in reducing sugar on incubation with testicular and, in some instances, with pneumococcal hyaluronidase. The amino sugar of each class of mucopolysaccharide was isolated after acid hydrolysis as the crystalline hydrochloride, and its nature ascertained by analysis and measurement of the optical rotation.

On the basis of this work, we can at present distinguish 5 mucopolysaccharides in connective tissues: (1) Hyaluronic acid, which is sulfate-free, has a specific rotation of $-70°$ to $-80°$, and is digested at a rapid rate by both testicular and pneumococcal hyaluronidase. (2) Chondroitin sulfate A, which has been found only in hyaline cartilage, has a specific rotation in neutral solution of $-30°$, and is hydrolyzed by testicular but not by pneumococcal hyaluronidase. (3) Chondroitin sulfate B, which has the same composition as A, a specific rotation of $-50°$, and is resistant to both testicular and pneumococcal hyaluronidase. On fractionation in calcium acetate solution by means of alcohol, it precipitates at an alcohol concentration of 20% (by volume). This fraction was first isolated from pigskin in 1941 (*6*). (4) Chondroitin sulfate C, which also has the same composition as A, but a specific rotation of $-20°$, and is hydrolyzed by testicular hyaluronidase at a rate that may be faster than that of ChS-A. It precipitates at an alcohol concentration of 50%. (5) Hyaluronosulfate, which has been obtained only from cornea (*7*). It has a specific rotation of $-56°$ and, like hyaluronic acid, is hydrolyzed by both testicular and pneumococcal hyaluronidase. Its amino sugar was found to be D-glucosamine in contrast to that of ChS-A, -B, and -C, from which D-galactosamine was obtained.

[2] C. Ragan and E. E. Fischel collaborated on part of the work on tendon and heart valves, respectively.

TABLE 1

OCCURRENCE OF MUCOPOLYSACCHARIDES IN MESENCHYMAL TISSUES

Group	Tissue	Hyaluronic acid	ChS-A $[\alpha]_D = -30°$	ChS-B $[\alpha]_D = -50°$	ChS-C $[\alpha]_D = -20°$
I	Vitreous humor	+	–	–	–
	Synovial fluid	+	–	–	–
	Mesothelioma	+	–	–	–
II	Hyaline cartilage	–	+	–	+ (?)
III	Heart valves	–	–	+	+
	Tendon (pig and calf)	±	–	+	+
	Aorta	–	–	+	+
IV	Skin (pig and calf)	+	–	+	–
	Umbilical cord	+	–	–	+

Heparin may be mentioned here as a possible sixth mucopolysaccharide occurring in the ground substance(s). Thus far we have not encountered heparin in identifiable concentrations, either because its concentration is too low or because this fraction may be lost in our isolation procedure.

We have summarized the sources of the mucopolysaccharides *based on isolation* in Table 1.

It can be seen that hyaluronic acid occurs in the absence of demonstrable quantities of sulfate esters in vitreous humor, synovial fluid (obtained both from cattle and from patients with rheumatoid arthritis), and the peritoneal fluid of a patient with a mesothelioma.

No hyaluronic acid is found in hyaline cartilage. The low sulfate values of some preparations of ChS-A prepared by this laboratory (*7*, *8*), as well as by other workers (*9*), are due to contamination with glycogen. The molar sulfate ratio approximates unity in our experience if subfractions are treated with commercial amylase. Solutions of (protein and glycogen-free) chondroitin sulfate on alcohol fractionation yield 2 fractions: a major fraction of a specific rotation of $-30°$ separating in fibrous form at low

alcohol concentrations, and a minor fraction of a specific rotation of $-20°$ to $-25°$ precipitating in flocculent form at higher alcohol concentration. Whether this fraction is identical with ChS-C of the fibrous connective tissues of Group III cannot be decided at present.

The most significant finding presented in Table 1 is the absence of hyaluronic acid from the 3 connective tissues of Group III—heart valves, tendon, and aorta. In all 3 tissues we found 2 sulfated mucopolysaccharides—ChS-B and ChS-C—in approximately equal quantities. In only one out of five isolation experiments performed on tendon was a small amount of hyaluronic acid found. We believe that this hyaluronic acid was derived from tendon sheaths that were present in this particular batch of tendon.

In contrast to the 3 tissues of Group III, skin and umbilical cord contain hyaluronic acid together with only 1 sulfate ester. In skin this sulfate ester is ChS-B, whereas in umbilical cord it is ChS-C. From both pig- and calfskin, no fraction corresponding to ChS-C could be isolated, and in umbilical cord ChS-B could not be detected. The quantities of both hyaluronate and ChS-C present in this embryonal tissue are many times larger than those found in normal adult tissues.

It may be mentioned here that human skin, both normal and pathological, has similarly been reported to contain hyaluronic acid, together with a sulfate ester presumed to be chondroitin sulfate (*10*).

In addition to strictly chemical problems, the observations reported raise many biological questions, among which may be mentioned the mechanism of formation and the anatomical locations of the various fractions, and their changes under the influences of physiological and pathological stimuli.

Histological techniques such as staining with metachromatic dyes and uptake of acidic and basic dyes at controlled pH values, or staining with the Hotchkiss method in combination with treatment of the histological sections with enzymes, have called attention to the accumulation in various diseases and in experimental conditions of material thought to be mucopolysaccharide in nature, such as in the nodules of rheumatoid arthritis (*11*), in the Aschoff bodies of rheumatic fever and in myocarditis in acute rheumatic carditis (*12*), in lupus erythematosus disseminatus (*13*), in myxedema, in granulation tissue (*14, 15*), in the skin of experimental mammals, and in the coxcomb on application of sex hormones (*16*) or pituitary hormones (*17*). In granulation tissue the quantity of the metachromatic material greatly diminishes as the scar matures (*12, 15*). In human skin the formation of dense collagen fibers is reported to be accompanied by a relative drop of the ratio of hyaluronic acid to chondroitin sulfate (*18*). Metachromatic material surrounds the elastic membrane of the smaller arteries, especially in the intima. In the larger elastic arteries like the aorta and its branches, much metachromatic material is found in the intima (*12*). It has been further pointed out that elsewhere elastic fibers are commonly associated with metachromatic material (*12*).

Other authors (*19*) postulate, on the basis of staining by the Hotchkiss-McManus technique, the presence of glycoproteins as essential components of the basement membranes of skin and of other organs. This basement membrane is said to be absent from embryonal skin but to increase in thickness with aging in skin and in the walls of blood vessels. Recapitulation of these observations may suffice to focus attention on the need for integration of histological data with chemical findings. From the scanty data available it appears that aging and pathological processes, rather than consisting merely in quantitative alterations, involve qualitative changes in the type of mucopolysaccharides present.[3]

Aside from questions of structure and anatomy of the ground substance, the problem of its physiological functions has been almost completely neglected. Although hyaluronic acid occurs in greatly hydrated gels and therefore may be involved in water binding (*21*), a similar function is not apparent for the sulfated mucopolysaccharides and their protein complexes. One function, however, suggests itself for these compounds—that is, their possible role as cationic exchange resins. The dissociation of the carboxyl groups in these compounds is suppressed by the much more strongly dissociated sulfate groups, and is so weak that it seems plausible to assume the ready formation of lactones under the influence of hydrogen ions and the subsequent opening of the lactone rings by hydroxyl ions. The anatomical location of such compounds in the basal membranes as suggested by Gersh and Catchpole would explain the orientation which has to be postulated for a system that has to function biologically.[4]

Experimental studies on the physiological role of the mesenchymal ground substances, and their response to regulation by hormones and to the action of the unknown noxious agents which cause the mesenchymal diseases, depend on the correlation of information obtained by chemical isolation, histological methods, and on studies of cellular metabolism. In such studies histology will play a predominant part, especially as methods are developed that can give more specific and quantitative information than those now in use.

[3] In this paper attention is concentrated on the mucopolysaccharides as components of the ground substance(s). We do not imply that this material is only, or even mainly, composed of polysaccharides. Thus far, we know almost nothing of the protein complexes as they occur in the ground substance except that the protein is not only firmly bound to the sulfated mucopolysaccharides but that it differs from collagen. From histological data it is known that proteolytic enzymes cause dissolution of the ground substance(s) at a rate faster than that effected by hyaluronidases (*19, 20*).

[4] It might be pointed out here that the mucoitin sulfate of the gastric mucosa (*22*) may play a similar catalytic role in the acid production or in the Na^+ shift of this organ.

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Tissue Respiration and Body Size[1]

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The relation between tissue respiration and body size has only recently attracted attention, though it is crucial for a classic and major topic of physiology. This relation is decisive for answering the question of whether the systematic decrease of metabolic rate per unit weight with increasing size, which is found in most animal classes and expressed by the so-called surface law and similar formulations, is based upon cellular or organismic factors. After earlier work of Terroine (*1*), Grafe *et al.* (*2,3*), Kayser *et al.* (*4*), which was inconclusive and contradictory, Kleiber (*5,6*) investigated the Q_{O_2} of liver from rats, rabbits, and sheep, and Weymouth *et al.* (*7*) the Q_{O_2} of the midgut gland of individuals of different size in the kelp crab *Pugettia*. These workers state a systematic decrease of the Q_{O_2} values with increasing size, in approximately the same extent as basal metabolism of the entire animal decreases. In a recent investigation, Krebs (*8*) compared the Q_{O_2} of 5 tissues of 9 different species. He found that, in general, Q_{O_2} values of the larger species are somewhat lower than the homologous values of small species; but there is no parallelism of this decrease in the different tissues, nor a consistent relation to the decrease of basal metabolic rate per unit weight with increasing size. There seems to be, as yet, no systematic investigation on the intraspecific size dependence of Q_{O_2} of different tissues.

In our experiments, albino rats (Wistar strain) were used, representing a continuous series from newborn animals of 9 g body weight to adults of 392 g.

[1] This work is supported by a grant from the National Cancer Institute of Canada.

TABLE 1

TISSUE METABOLISM AND BODY SIZE IN THE ALBINO RAT

	No. of experiments	Mean Q_{O_2}	Mean Q_{O_2} for body wt			
			0–50	50–150	150–250	250+
Heart	33	9.09 ± .49	10.68	8.48	8.45	7.93
Lung	35	7.15 ± .25	7.90	6.50	6.93	6.34
Liver	49	8.62 ± .22	9.03	9.08	7.20	7.55
Kidney	48	15.50 ± .36	15.70	14.19	16.42	16.85
Brain cortex	30	8.62 ± .25	8.25	8.70	8.35	9.92
Thymus	32	8.25 ± .33	9.04	8.75	7.06	6.99
Diaphragm	26	6.26 ± .51	8.99	6.08	4.75	4.87

The Q_{O_2} (μlO_2/mg dry wt/hr) of heart, lung, kidney, liver, brain, thymus, and diaphragm was determined by the Warburg method. The tissue slices were taken from animals under basal metabolism regime (10–18 hr fasting). Respiration was measured in Krebs-Ringer phosphate solution (pH, 7.4) and in an atmosphere of oxygen. Higher Q_{O_2} values can be obtained in other media; but this was considered to be immaterial for the present purpose, which amounts to a comparison under standard conditions. There was no decline in the intensity of respiration during the experimental period (1 hr) except in brain tissue. The total number of determinations presented here is 253.

The order of the differences to be expected if the decrease of basal metabolic rate is based upon differences in tissue respiration can be estimated as follows. It appears that the surface rule holds intraspecifically for the rat (*9*); this is also stated by Kleiber (*10*), according to Benedict's data (*11*). Then

$$M = bW^{2/3}, \tag{1}$$

if M is the rate of basal metabolism, W the body weight, and b a constant; and correspondingly

$$\frac{M}{W} = bW^{-1/3} \tag{2}$$

for metabolic rate per unit weight. If, for example, the weights compared are 1 : 2 : 4 : 8 : 16, metabolic rates per unit weight (a measure of which is Q_{O_2}) should decrease in the ratio 1 : 0.79 : 0.63 : 0.50 : 0.4. Such differences should be easily detected by the Warburg method. We would not expect that the rate of decrease of Q_{O_2} with increasing size is the same in all tissues, but even then significant differences of the Q_{O_2} values should be found.

Actually, we did not find in our experiments systematic differences which would account for the decrease of the rate of total metabolism with increasing size (Table 1). A slight decrease in the average Q_{O_2} values is noticeable in some tissues (liver and heart) and especially in the diaphragm. But it is definitely smaller than the extent postulated by the surface rule, and not systematic with respect to the various tissues. Also if, instead of the surface rule, the 3/4 power of

weight, recommended by Kleiber and others as "metabolic unit of body size," should be adopted, these conclusions are not altered.

Our results, obtained in intraspecific comparison, correspond to the results of interspecific comparison obtained by Krebs (which came to our attention only after the beginning of our study). The experiments seem to be a blow to the hypothesis that the decrease of basal metabolic rates with increasing size is due to cellular factors, as expressed by Weymouth *et al.* (*7*): "The regressions of the weight-specific rates for the different tissues apparently form, in the log-log plot, a family of parallel lines, some higher and some lower, corresponding to the intensity of respiration, but all showing the same slope as the regression of the weight-specific rate of the entire animal" (p. 68). None of these statements is substantiated by our experiments. It appears that the main regulative principle responsible for the systematic decrease of weight-specific basal metabolic rate with increasing size must be sought in factors lying in the organism as a whole.

A full presentation of the data obtained will be given elsewhere.

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Effect of Germination on the Carotene Content of Pulses and Cereals

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In our studies on the effect of germination on the vitamin content of pulses we have observed increased formation of ascorbic acid (*1*, *2*), nicotinic acid (*3*), thiamine (*4*), and riboflavin (*5*), in different varieties of pulses during the process. In the present communication the effect of germination on the carotene content of different pulses and cereals is presented.

Five g of healthy dry seeds of pulses were germinated with distilled water in clean Petri dishes, which were kept away from direct sunlight. In the case of cereals, the seeds were embedded in earth soaked with water in Petri dishes for proper germination. After germination for varying periods the seeds were crushed. Carotene was extracted by the method of Guilbert (*6*), as modified by Peterson, Hughes, and Freeman (*7*), and estimated with a Lumetron photoelectric colorimeter using a 440-mμ filter. The results are shown in Tables 1 and 2.

TABLE 1

Effect of Germination on the Carotene Content of Pulses

Local name	Botanical name	Days of germination				
		0	1	2	3	4
		Mg/100 g of pulse				
Krishna mung	*Phaseolus radiatus*	3.75	4.35	4.40	4.70	4.75
Musuri	*Lens esculenta*	1.60	1.60	2.00	3.90	4.05
Hara chhola	*Cicer arietinum*	3.10	3.80	4.00	4.20	4.50
Golapi chhola	" "	1.95	2.10	2.40	2.75	3.00
Chhola	" "	2.95	3.35	4.20	4.30	4.35
Mung	*Phaseolus radiatus*	2.15	3.60	3.75	3.80	3.80
Barbati	*Vigina sinensis*	0.70	1.40	1.50	1.60	1.55
Pyra mator	*Pisum sativum*	1.50	1.60	2.00	2.25	2.30
Sona mung	*Phaseolus aurus roxburgi*	2.35	2.95	3.25	3.10	3.15
Kalai	*Phaseolus mungo*	1.25	1.68	1.85	2.10	2.30
Mas kalai	*Phaseolus roxburgi*	1.75	2.10	2.75	2.80	2.80
Kabuli chhola	*Cicer arietinum*	2.05	2.95	3.45	4.15	4.30
Pea	*Pisum sativum*	1.20	1.35	1.50	1.75	2.35

TABLE 2

Effect of Germination on the Carotene Content of Cereals

Cereal	Days of germination							
	0	1	2	3	4	5	6	7
	Mg/100 g of cereal							
Paddy (*Oryza sativa*)	0.35	0.40	0.75	1.35	2.15	2.85	3.25	3.95
Wheat	0.45	0.43	0.70	1.50	2.25	3.25	4.50	4.65
Corn	4.00	4.00	4.35	4.95	5.25	5.75	5.95	6.15

Pulses contain a good amount of carotene in the dry condition. Paddy and wheat, however, do not contain much carotene, whereas corn is a rich source of carotene in the dry condition. In all cases, the carotene content increased considerably as the germination proceeded. In cereals, on the first day of germination there is not much change in the carotene content, probably because the seeds do not sprout well. But as the shoots develop the carotene content increases gradually. After the third day of germination the color of the shoots is changed from yellow to green, which probably indicates that chlorophyll and other plant pigments increase during germination; carotene being a pigment, also, increases simultaneously with the other pigments. From the results obtained it is clear that the rate of increase in the carotene content of both pulses and cereals depends on the rate of growth of their seedlings. Pulses form an important ingredient in the Indian diet. The germinated pulses are, therefore, nutritionally superior to the unger-

minated for their increased carotene content as well as for their content of other vitamins (*1–5*).

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Deviations from Beer's Law in the Ultraviolet Absorption Spectra of Some Organic Compounds

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In the course of an orientation study of 3-substituted diphenyl ethers, deviations from Beer's law were observed in the absorption spectra of phenols and acetamino compounds derived from diphenyl ether.

Although instrumental deviations occurred at the high-intensity absorption bands, the major part of the deviations resulted from density values below 1.5, which are considered due to fluorescence (*1*). In an effort to trace the chromophore responsible for the deviations, absorption spectra were determined in various concentrations (0.002–0.00001 moles/l) for phenol, nitrobenzene, acetanilide, diphenyl ether, 4-nitrodiphenyl ether, and 3-acetaminodiphenyl ether. The results indicate that some of these substances show deviations from Beer's law in alcoholic solution even at these low concentrations. If instrumental deviations are disregarded, the largest anomalies are observed with phenol (Table 1). The deviations are believed to account at least in part for the discrepancies among the absorption values reported in the literature (λ_{min}, 236–241 mμ; log ε_{min} 1.69–2.0; λ_{max}, 262–274 mμ, log ε_{max} 3.1–3.3) (*2–5*). Acetanilide has λ_{max} 242 mμ (log ε 4.11), and nitrobenzene absorbs maximally at 260 mμ (log ε 3.90), λ_{min} 225 mμ (log ε 3.40). Both compounds show deviations only in high concentrations, and the absorption values agree with the literature (*6*).

TABLE 1

Absorption Spectra of Phenol in 95% Alcohol

Moles/liter	λ_{max_1}	log ε_{max_1}	λ_{min}	log ε_{min}	λ_{max_2}	log ε_{max_2}
0.00008	219	3.44	No absorption*		275	2.86
.00016	219	3.62	"	"	275	3.08
.00042	220	3.64	238	1.78	275	3.22
.00085	222	3.68	239	1.81	275	3.43
0.00212	225	3.00	240	0.67	272	3.05

* Between 235 and 258 mμ.

Contrary to published data (*7*) diphenyl ether gives absorption curves even in alcohol which show the characteristic fine structure, three sharp maxima at 265, 271, and 278 mμ, and three minima at 252, 267, and 276 mμ. Isosbestic points are observed at 260 and 280 mμ and small deviations from Beer's law in the region of the maxima (log ε_{max_1} 3.18–3.24, log ε_{max_2} 3.26–3.31, log ε_{max_3} 3.21–3.26).

Deviations in 3-acetaminodiphenyl ether (λ_{max} 277 mμ, λ_{min} 276 mμ) occur at the maximum, in 4-nitrodiphenyl ether (λ_{max} 302, λ_{min} 248) only over the region of the minimum.

It appears from the present data that deviations from Beer's law can occur also with diphenyl ethers and phenols in addition to hydrocarbons (*1*), acrylic acids, and esters (*8*), dyes, and other substances (*9*). The increasing number of compounds with concentration-dependent light absorption emphasizes the need for reporting of concentrations, which is unfortunately rarely done in the literature.

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Arginase Activity in Human Skin[1]

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Arginase activity in mammalian skin has been demonstrated by Greenstein (*1*), who found that the normal skin of mice contained about 1/10 the amount found in the liver, and roughly ½ that found in pigmented melanomata of the same animals.

In the present study it was attempted (1) to ascertain the presence of arginase in human skin, and (2) to determine its variations and distribution in normal skin and in cutaneous lesions.

Skin samples from fresh biopsies were crushed in a piston-cylinder apparatus, suspended in normal saline, and then incubated with manganous ion to activate the enzyme (*2*). Incubation was then carried out with arginine as a substrate for ½ hr, and the reaction stopped by the addition of sulfuric acid (*3*). The

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[2] The author is indebted to Stephen Rothman for valuable advice in carrying out the experiments and in preparing this manuscript.

TABLE 1

ARGINASE ACTIVITY OF NORMAL WHOLE SKIN FROM SURGICAL SPECIMENS OF FEMALE BREASTS

Specimen	Arginase activity
1	316
2	490
3	238
4	282
5	562
6	202
7	372
8	277
Average	355

initial and final urea values were determined in the Warburg respirometer by the urease method, first described by Krebs and Henseleit (*4*). The enzyme activity is expressed in mg of urea-N liberated/100 g of wet weight tissue.

Estimation of arginase activity in skin from female breasts, which was either worked up right after it was received from the operating room, or maintained in a frozen state until worked up later, revealed that human skin has a considerable amount of arginase activity (Table 1).

Estimation of the enzyme's activity in isolated epidermis and corium, separated either roughly by mechanical means or quite accurately by the heat method (*5*), showed that most of the enzyme (about 90%) is found in the epidermis (Table 2). In using the heat method of separation the skin loses about 50% of its arginase activity. This loss is corrected for in Tables 3 and 4.

Common warts, which are characterized by considerable proliferation of the prickle cells of the Malpighian layer, showed an arginase activity much higher than normal epidermis. The values found in the warts studied would indicate that the Malpighian cells in the wart have an average eightfold higher arginase content than normal Malpighian cells (Table 3). In patches of psoriasis, also associated with proliferation of the Malpighian layer, high values were obtained, though not as high as those found in common warts.

As contrasted with common warts, the main histologic feature of so-called seborrheic warts, or seborrheic keratoses, is not a proliferation of the prickle cells of the Malpighian layer but a benign proliferation of the basal cells (*6*). In these lesions, as well as in basal cell carcinomas, no such unusually high arginase values were encountered as in common warts.

TABLE 2

ARGINASE ACTIVITY OF EPIDERMIS AND CORIUM (HEAT-SEPARATED) OF NORMAL SKIN FROM FEMALE BREASTS

Epidermis	Corium	Activity ratio of corium/epidermis
1,515	146	1: 10.5
1,672	148	1: 11.5
1,450	178	1: 8.2

On the contrary, in seborrheic warts and in basal cell carcinomas the values were conspicuously low (Table 4).

These results indicate that the arginase activity of the skin is located predominantly in the Malpighian prickle cells of the epidermis and that the basal cells contain much less of the enzyme—if any.

It is generally considered that the prickle cells continuously derive from the basal cells. This never has been clearly demonstrated, however. The two layers become quite distinct early in fetal life; in the human embryo, for example, they are differentiated in the tenth week. The great difference in enzymatic activity suggests that possibly the two layers, after their differentiation, are independent of each other in their perpetual renewal.

TABLE 3

ARGINASE ACTIVITY OF COMMON WARTS

Activity of wart	Activity ratio of normal whole skin/wart	Activity ratio of normal epidermis/wart
16,900	1: 48	1: 5.5
34,400	1: 95	1: 11.0
6,030	1: 17	1: 2.0
43,500	1: 121	1: 14.0
Average 25,207	1: 71	1: 8.0

TABLE 4

ARGINASE ACTIVITY OF MISCELLANEOUS LESIONS

Lesion	Arginase activity	Activity ratio of normal epidermis/lesion	Activity ratio of lesion/wart
Seborrheic keratosis	685	1: 0.22	1: 37
" "	1,223	1: 0.40	1: 20
Basal cell carcinoma	2,370	1: 0.77	1: 10.7
" " "	680	1: 0.22	1: 37
Basal-intermediate cell carcinoma	4,700	1: 1.4	1: 5.4

It has been suggested that urea is formed in the sweat glands by the action of arginase on arginine (*7, 8*). Such mechanism would explain the well-known fact that the urea concentration of sweat is always higher than that of blood. However, with the method employed in this study no arginase activity could be demonstrated in fresh human sweat produced by exposure to heat.

A more detailed report of this work will be published elsewhere.

Addendum: Following the submission of this report for publication the author's attention was called to the work of Mardashev and Semina, which was reported in the Russian literature (*Biokhimiya*, 13, 236 [1948], quoted by *Chem. Abs.*, 42, 7806g [1948]). According to the abstract these workers have also demonstrated the presence of arginase in human skin and similarly have noted its concentration in the epidermis.

Recent work in this laboratory indicates that within the epidermis proper the greatest arginase activity is localized in the cells of the upper portions of the Malpighian layer and seems to reach its maximum in the granular layer.

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A Method of Intravenous Injection of Drugs from a Distance in Conditional Reflex Studies

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The study of higher nervous activity through the medium of conditional reflexes usually requires that the animal be isolated from both the experimenter and all irrelevant stimuli. Procedures requiring a series of injections of measured amounts of a drug have not been possible because of the lack of a satisfactory technique. This deficiency had to be overcome before we could investigate cardiac, respiratory, and salivary conditional reflexes in which acetylcholine is used as the unconditional stimulus. In the studies planned, repeated intravenous injections of the drug are necessary, but it is essential to avoid any disturbance of the animal during the course of the injections. The technique described below permits the intravenous injection of measured quantities of a drug while the investigator is separated from the animal, thus avoiding the disturbing effect of the investigator's presence, repeated introduction of the needle, etc.

The authors (*1*) recently described a method for injecting acetylcholine into the superior sagittal cerebral venous sinus, in the isolated, unanesthetized dog. This technique has been modified by the use of plastic tubing inserted into the external jugular or radial vein, as described here. Fitzpatrick, Schnabel, and Peterson (*2*) used plastic tubing for cardiac catheterization, by introducing the tubing into the heart through the external jugular vein. In our experiments a very fine-bore plastic tube about 3 in. long with a steel wire stylet already in place is inserted into the external jugular vein of an anesthetized dog. This is accomplished by first introducing a special 16-gauge needle into the vein and then passing the plastic tubing through the needle. The needle is pulled out over the

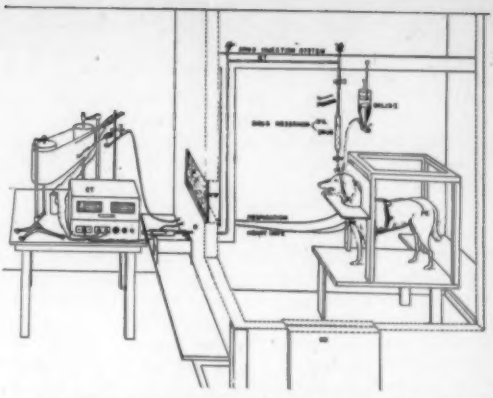

FIG. 1. Arrangement of injection apparatus and dog during experiment: *E*, electrodes for heart rate; *P*, pneumograph; *PT*, plastic (polyethylene) tubing; *T*, Y-tube; *GT*, oil-filled glass tubing; *CT*, cardiotachometer; *CD*, camera door; *O*, outlet for oil-filled tubing; *VW*, viewing window—one-way vision from outside camera; 1, 2, and 3, stopcocks.

tubing, which may be left in the vein for several days. The protruding end of the stylet is then bent at its point of exit so as to prevent accidental movement inward, lest it extend beyond the inner end of the tubing and injure the vein. The bent end of the stylet is sutured to the skin. On the following day, after the dog has recovered completely from the anesthesia, it is placed in the camera under slight restraint and with the injection apparatus applied as illustrated in Fig. 1. A 23-gauge needle with shortened bevel is inserted into the plastic tube (Fig. 1, *PT*) after removal of the stylet, and the needle is fixed to the neck by means of adhesive tape. A metal Y-tube (Fig. 1, *T*), with adapters at the end of the stem and on the arms, is attached to the needle. One arm is connected to a saline solution, and the other to a drug reservoir, which is a glass tube 6 in. long and ½ in. in diameter, tapered at both ends to permit the attachment of

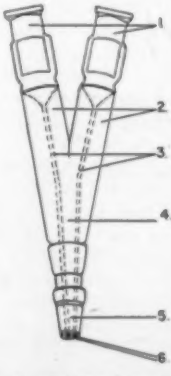

FIG. 2. Y-tube showing details of construction: 1, adapters of arms; 2, arms of Y-tube; 3, inner tubes; 4, stem of Y-tube; 5, adapter; and 6, open ends of inner tubes.

rubber tubing. The Y-tube serves merely as a sheath to contain 2 smaller tubes completely isolated from each other, extending from the arms of the Y and terminating at the end of the stem (Fig. 2). A constant flow of saline is thus maintained through one arm of the Y and the plastic tubing, to prevent occlusion of the latter by blood clotting. At the lower end of the drug reservoir there is a glass stopcock (Fig. 1, 1) which, when closed, prevents the escape of the drug solution until ready for use. The upper end of the drug reservoir is joined by means of plastic tubing to glass tubing (Fig. 1, *GT*) filled with mineral oil. Oil is also added at the upper end of the drug reservoir, so as to float on the surface of the drug solution (Fig. 1). A glass stopcock (Fig. 1, 2) at the end of the glass tube permits detachment of the reservoir for cleaning purposes and for the replenishment of the drug, without loss of oil. The distal end of the oil-filled glass tube passes through an outlet in the wall of the camera (Fig. 1, *O*) in which the dog is isolated, and the escape of oil is prevented here by means of another glass stopcock (Fig. 1, 3). During

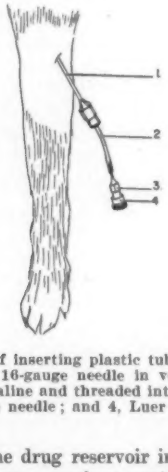

FIG. 3. Method of inserting plastic tubing into radial vein of dog: 1, special 16-gauge needle in vein; 2, polyethylene tubing filled with saline and threaded into vein through large needle; 3, 23-gauge needle; and 4, Luer lock cap.

injection, with the drug reservoir in place, and stopcocks 1 and 2 open, a syringe containing mineral oil is attached to the adapter-equipped distal end of the oil-filled tubing. Then stopcock 3 is opened. The injection of a measured amount of oil displaces an equal amount of drug from the reservoir into the external jugular vein.

This method of injection has also been carried out in the radial vein. No anesthesia is required here, as this vein is readily accessible in the foreleg and easily pierced by the special 16-gauge needle, with little resistance on the part of the dog. The leg used is restrained to limit its range of movement to several inches. The plastic tubing to be inserted into the vein is prepared by insertion of a ½-in., 23-gauge needle into one end, and filling the tubing with saline. A Luer lock cap is then attached to the needle to prevent the escape of the saline, which serves to keep blood from entering the plastic tubing while it is being inserted

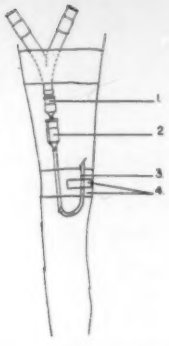

FIG. 4. Arrangement of Y-tube and plastic tubing during injection of drug into radial vein: 1, 23-gauge needle with Y-tube replacing Luer lock cap; 2, 16-gauge needle withdrawn from vein but left on tubing; 3, plastic tubing in vein and taped in place; 4, adhesive tape.

into the vein. The plastic tubing is then passed through the needle into the vein (Fig. 3). The extravenous part of the plastic tubing is bent upward to form a U, so that the needle in the tubing can be attached to the stem of the Y-tube (Fig. 4). The 16-gauge needle, after being withdrawn from the vein, is left on the plastic tubing because the 23-gauge needle prevents its removal. When the radial vein is used, a longer piece of tubing is required to connect the upper end of the drug reservoir to the oil-filled glass tubing. The advantage of using the radial vein is that the plastic tubing is introduced just before the experiment is started and removed at the end of each experiment.

In experiments in process it has been possible to inject 0.2 and 0.4 ml of a 1% solution of acetylcholine chloride repeatedly, without disturbing the dog. With each injection there resulted a short period of inhibition of cardiac activity followed by compensatory acceleration of the heart rate (Fig. 5). With a bell as a conditional stimulus, experiments are being carried out to determine whether the cardiac inhibition or compensatory rise following the injection of acetylcholine as the unconditional stimulus can be condi-

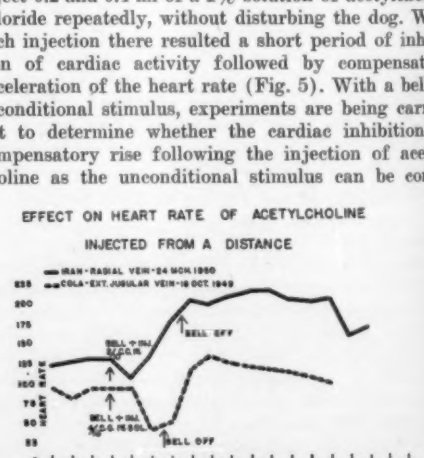
EFFECT ON HEART RATE OF ACETYLCHOLINE
INJECTED FROM A DISTANCE
IRAN - RADIAL VEIN - 24 NOV. 1950
COLA - EXT. JUGULAR VEIN - 18 OCT. 1949
HEART RATE
BELL OFF
BELL OFF
TIME IN 5" PERIODS

FIG. 5. Effect on heart rate of acetylocholine injected intravenously from a distance. Arrows indicate duration of the bell-ringing used as the conditional stimulus. Drug was injected at the same time bell was started. Injection required several seconds.

tioned. It is planned to study similarly the effects on respiration and salivation, as acetylcholine inhibits respiration and causes increased secretion of saliva. Other related humoral agents will also be investigated.

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A Suggested Biosynthesis of Cyclopropane Rings

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An unusual fatty acid was recently reported by Hofmann and Lucas (*1*). In addition to possessing an odd number of carbon atoms, the acid gives chemical reactions which point strongly to the presence of a three-membered ring. The authors formulated the structure in a general way as I.

$$CH_3(CH_2)_xCH\text{—}CH(CH_2)_yCOOH \quad (\text{with a CH bridge}) \qquad x+y=14$$

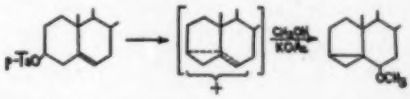
I

The x-ray diffraction pattern indicated a chain length in the 18-carbon range (*1*), an observation consistent with other information on the cyclopropane ring with regard to size and geometry (*2, 3*). Walsh (*3*), among others, has collected a good deal of information on the similarity of the cyclopropane ring to the ordinary double bond, focusing most attention on the availability of electrons (measured by spectra, conjugation, reactivity, etc.). Externally, the cyclopropane ring is analogous to a double bond, although "weaker" as an electron source, or as a conjugating group. Therefore, an organism which was not selective to a high degree would have a difficult time distinguishing between a C_{18} fatty acid and the C_{19} fatty acid containing the cyclopropane ring. The new acid was isolated from the lipid fraction of *Lactobacillus arabinosus*, and the acid may well serve to replace some C_{18} fatty acid.

Cyclopropane rings are a rarity in natural products, and only certain terpenes, the thujanes, caranes, and sabinenes, which contain a three-membered ring as well as a six, occur to any extent (*4*). Since three-membered rings are formed with relative difficulty in the laboratory, the biosynthesis of such rings becomes of interest. Most preparations utilize the displacement of halide by an anion formed by a strong base. Anion formation takes place when the hydrogens are "activated" by a neighboring group such as carbonyl which withdraws electrons. A typical synthesis (*5*) of this type is:

$$Cl\text{—}CH_2CH_2CH_2CN \xrightarrow{NaNH_2} [Cl\text{—}CH_2CH_2\ddot{C}H\text{—}CN] \longrightarrow CH_2\text{—}CH\text{—}CN \quad (\text{with a } CH_2 \text{ bridge})$$

One known method of formation is more amenable to biosynthetic conditions. Stoll (*6*) discovered that solvolysis of cholesteryl *p*-toluenesulfonate in methanol buffered with potassium acetate led to the formation of an ether isomeric with cholesteryl methyl ether. Wallis *et al.* (*7*) in this country and Heilbron *et al.* (*8*) in England have elucidated the structure of the product, and Winstein (*9, 10*) has proposed a mechanism to fit the available data. The formation of isomeric (or i-) methyl ether may be formulated as follows:



The reaction is not limited to the sterol series, but no careful work on aliphatic compounds has been performed for the purpose of clarifying the mechanism.

The formation of the cyclopropane ring seems to depend on two related factors: (1) the ionization of a bond, and (2) the presence of a double bond in the proper relation to the ionizing bond. These are connected in the proposed mechanism because the double bond can aid the ionization by supplying electrons. Ionization also depends upon the character of the anion formed, and experience shows that the anions of strong acids (like the *p*-toluenesulfonate ion) are favorable.

With these facts in mind, a biosynthetic route to the acid, I, may be suggested. The precursor must possess the structure II in which *X* is a group which will promote the process of ionization. Ricinoleic acid, III, the only common (*11*) hydroxy-unsaturated fatty acid, fulfills the requirement after the hydroxyl has

$$R\text{—}\underset{X}{\overset{H}{C}}\text{—}CH_2CH{=}CHR'$$

II

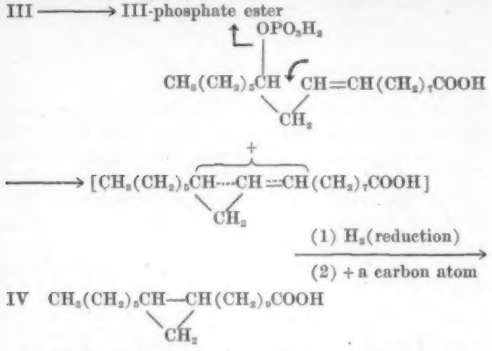
$$CH_3(CH_2)_5\underset{O}{\overset{H}{C}}HCH_2CH{=}CH(CH_2)_7COOH$$

III

been converted to the phosphate ester by a phosphorylating enzyme system in a common variety of biochemical transformation. After or during ring closure, reduction would lead to a C_{18} acid; however, this acid would resemble a C_{17} straight chain acid and could conceivably be changed to a C_{19} acid (C_{18} analogue) by some such series of reactions as phosphorylation of the carboxyl group, condensation with acetate, conversion to a 2-ketoacid, and decarbonylation. On the foregoing basis, structure I will appear as IV. A chemical synthesis of IV could be designed with ricinoleic acid as starting material and utilizing the

[1] U. S. Public Health Service Research Fellow of the National Institutes of Health, 1949–52.
[2] The author would like to express his appreciation to S. Winstein for helpful discussion.

"i-sterol" effect for the formation of the cyclopropane ring in a manner parallel to the biosynthesis.



Proof of this particular suggestion will depend on the validity of the structure IV proposed for the new fatty acid, but the general biosynthetic route outlined above may still be a reasonable hypothesis for the explanation of the formation of cyclopropane rings in natural products.

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Separation of Rusty Mottle of Cherry from a Ring-Spot–Rusty Mottle Complex[1]

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Most sweet and sour cherries carry the ring-spot virus in a more or less latent condition. This has caused considerable confusion in the study of cherry viruses on other species of *Prunus*. Often the symptoms described for the reaction on some specific host were not that of the original cherry virus but of the latent ring spot. In their work with mild rusty mottle virus, Zeller and Milbrath (*1*) reported the interference of the ring-spot virus in studying rusty mottle on peach. Whenever peach was inoculated with different sources of mild rusty mottle a reaction would occur which was typical of the ring-spot complex. At first this was believed to be a reaction of mild rusty mottle virus, since return inoculation from such peach trees always gave rusty mottle symptoms on cherry.

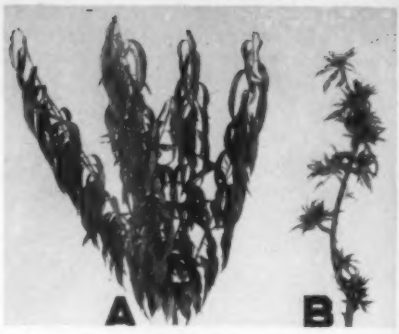

FIG. 1. Early Muir peach inoculated with: *A*, rusty mottle virus after removal of ring-spot complex; *B*, rusty mottle before removal of ring-spot complex.

From this work it became apparent that it would be valuable to have a method whereby the ring-spot virus could be separated from other stone fruit viruses. Since the ring-spot virus goes to most stone fruit varieties, separation on differential hosts based on susceptibility did not offer much promise. The local necrotic lesion type of reaction that occurs when ring-spot virus is budded into Shirofugen flowering cherry (*Prunus serrulata* var. Shirofugen) (*2, 3*) suggested a possible method of separation. If the ring-spot virus would move out more slowly than the second virus and remain somewhat localized in the inoculated branch, it would be possible to isolate the second virus beyond the region infected by ring spot.

In August three buds infected with ring spot and mild rusty mottle were placed near the terminal of a Shirofugen branch. By the following spring the inoculated branch showed severe gummosis and necrosis, indicating that the ring-spot virus had moved out into the Shirofugen. Buds were taken from several different branches not showing the ring-spot reaction and inoculated into Bing cherry. No symptoms of mild rusty mottle developed in the test tree, indicating the ring-spot virus had moved out of the infected bud, first killing a band of cells about the inoculation point and thus preventing the spread of the mild rusty mottle virus.

In order to avoid this direct exposure of Shirofugen tissue to the ring-spot virus before the mild rusty mottle virus had had an opportunity to move out into the Shirofugen, a second experiment was planned whereby both viruses would move through a non-necrotic host before coming in contact with Shirofugen. Ring-spot–free branches of Bing cherry were established on a 5-year-old Shirofugen tree. When these branches were 4–5 ft long, two cherry buds infected with both the ring-spot virus and mild rusty mottle virus were placed at the terminal portion of one of the

[1] Published as Technical paper No. 651 with the approval of the director of the Oregon Agricultural Experiment Station. Contribution from the Department of Botany and Plant Pathology.

Bing branches. These inoculations were made in August, and by the following April the ring-spot virus had moved out of the Bing branch, as evidenced by a streaking type of necrosis that involved about one third of the tree. The ring-spot virus had spread more rapidly and in a more systemic manner by this method of inoculation than by direct budding into the Shirofugen. The extent of the spread of the ring-spot virus was determined by slashing the bark and examining the exposed tissue for necrotic streaks.

Buds taken from the area showing necrotic streaking and placed into Shirofugen and Bing cherry showed both viruses to be present. At this time buds taken beyond this area contained neither virus.

In July the other Bing branches that had not been inoculated showed early rusty mottle symptoms, and the necrotic streaking caused by ring-spot virus had not yet reached the Shirofugen immediately below these branches. Buds transferred from these branches to virus-free Bing trees and Shirofugen demonstrated that the two viruses have been separated. Mild rusty mottle was established in a virus-free Bing without the ring-spot contaminate.

The successful separation of the mild rusty mottle virus from the ring-spot complex has made possible the study of the mild rusty mottle virus in peach. When Early Muir peach trees were inoculated with mild rusty mottle free from latent ring-spot virus, the results were entirely different from those of the original inoculations before the separation of the two viruses. The peach showed none of the severe shock reaction (Fig. 1, *B*) which is now known to be a symptom associated with certain strains of ring-spot virus. The mild rusty mottle virus was carried without apparent symptoms (Fig. 1, *A*). Return inoculation from peach to Bing cherry demonstrated the virus to be carried without symptoms in peach; the ring-spot virus may be carried without symptoms in cherry.

These findings emphasize the importance of recognizing ring-spot virus as a common contaminate in most stone fruit virus sources. Before these viruses can be studied as single entities, the ring-spot complex must be removed. The Shirofugen technique described offers a possible method of accomplishing the separation.

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Comments and Communications

The Problem of an International Language

It strikes me that Ancel Keys is on thin ice when he rebukes the editor of *Acta Physiologica Polonica* for chauvinism in printing in Polish and not giving résumés in other languages—especially English!

What American journal—at least the biological ones I am familiar with—condescends to print foreign language résumés? None. How many American scientists really bother to learn other languages so that they are facile in them? Very few. And I am not innocent, either.

And what if the first issue is devoted to Pavlov? A great physiologist is entitled to an anniversary volume, it seems to me.

When Dr. Keys publishes a paper in Polish, or at least with a Polish résumé, then and not till then, do I think it proper for him (or anyone) to complain of chauvinism on someone else's part.

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In transmitting his letter written to Professor W. Missiuro of the Akademia Lekarska in Warszawa, Poland, on the occasion of the publication of Volume I of *Acta Physiologica Polonica* (*Science*, **112**, 724 [1950]), Ancel Keys stated: "I, at least, am greatly disturbed to see such evidence of growing chauvinism in science in some parts of the world and feel we scientists should be alert to express such concern."

While one may regret the fact that only 20, or fewer, physiologists outside Poland and Russia can read articles in Polish, this seems to me no justifiable reason for denying the editors of the new journal the right to publish in the tongue most easily used by contributing authors. If allowed to use their natural tongue many writers will publish much of scientific value that would remain unpublished (and therefore totally inaccessible) if it had to be translated into English or German, as Dr. Keys has suggested. It is a much more difficult thing to write accurately and fluently in a tongue other than one's own than it is to garner meaningful data from an article already expressed with scientific exactness in a tongue not natural to the reader.

To require minority linguistic groups to publish in languages other than their own would be to handicap whole nations of scientists to the point of reducing productiveness. If Polish journals are to be required to publish English and German summaries, why should not all English-using journals be likewise required to publish summaries in two other languages for the benefit of the scientific public who do not easily read English?

Is not the very implied assumption that English-using journals be exempt from the need to translate

a true unconscious chauvinism in English-speaking peoples? It is just this air of superiority that has brought Americans much criticism and dislike abroad.

In our time it is imperative that everyone avoid international antagonism wherever honorably possible. Ought not scientists, who profess at least a professional "world citizenship," be leaders in this respect?

The core of the difficulty, then, is not the fact that a minority linguistic group is using a minority language in publishing material of international importance, but rather that all countries, of whatever linguistic persuasion, are publishing in so many varied languages that it has become a real burden to scientists merely to keep informed of scientific happenings recorded through so many linguistic media.

At present most scientists aspiring to advanced degrees are required to demonstrate some facility in reading two foreign languages. These languages, of course, help to a greater or less degree in opening the doors to a wider view of scientific writings, but the device is woefully inadequate. If it were possible to set up a single language as a standard medium of scientific expression for summaries of articles of international importance, that would, I think, be a step in the right direction. In such an event, every scientist could concentrate on learning the common language, and all writings of international interest could be summarized in the common language.

The chief difficulty in such an undertaking as deciding on a common language would, of course, be the natural tendency of each country to feel that her language is most eminently fitted to be the common language for international scientific expression. Minority groups especially might be expected to resent the imposition of a majority-group language upon them. One feasible solution, and the best I can think of, would be the use of a well-worked-out, accurate, nonnational language such as Esperanto.

Esperanto, with its serious consideration by the United Nations at the present time, is coming of age. It has, in the past two generations, grown from a somewhat inept, imperfect, and little-used language into a very adaptable language, capable of exact expression and used by many diverse peoples over the world. It is much simpler to learn, being much less complex than any national language. Would it not be at least worthy of consideration as a workable solution to a confusing situation?

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Stine Laboratory
Newark, Delaware

DR. LINCICOME takes exception to the word "chauvinism," which he considers particularly objectionable. Well, perhaps it is, since it tends to have emotional connotations for some people. I contend, however, that it is reasonable to ascribe, or at least to suspect, the influence of chauvinism in the decision to publish the *Acta Polonica Physiologica* without any consideration for the vast majority of physiologists, who cannot understand a word of it and yet who have, I am sure, the most friendly interest in the work and welfare of our colleagues in Poland.

The end of the late World War brought with it a sudden disappearance of non-Russian abstracts in the Russian scientific literature, and this coincided with an organized attack on everything considered to be outside the articles of the faith of Russian Communism. I find it hard to believe that the Russians changed their publication policy simply to make their scientists happier and more effective. I think it will be difficult to defend the thesis that the trend in all such matters behind the Iron Curtain is not chauvinistic and that no such tendency is probable in the small matter of the policy of the *Acta Polonica*.

Certainly there will be many who will join me in genuine regret that we shall be unable to gain any inkling as to what our Polish friends are doing or saying. And most of us will hope, as implied in my letter, that Polish physiology will prosper actively without undue concern as to what may be "idealistic" or "materialistic" in particular experiments and measurements.

I cannot agree with Dr. Lincicome that minority and majority languages can be equated, or that purely practical considerations must be rejected on the ground that everyone has the right to express himself in the language most convenient to him personally. We may, of course, pursue scientific researches for the sole reason of personal and individual curiosity or aesthetic satisfaction. If, however, we have any feeling of the community of man, we have an obligation to communicate with others and to learn what other persons of similar bent have thought or done on the problems that intrigue us. In all of this I may or may not be primarily motivated by the urge to make a better world for all mankind, but I and my fellows certainly do not wish the world ill.

English happens to be my native tongue, and I am not a linguist, but I have made efforts that enable me to read, with decreasing order of facility, German, French, Spanish, Danish, Italian, and even Dutch and Portuguese. I have not been conspicuously successful in this enterprise, partly from absolute lack of time and partly because my best guesses as to the probable importance of available articles have meant practice with the several languages in the order named above. I see no possibility of learning Polish, or Hungarian, or Bulgarian, or Albanian, which distresses me if I am thereby to miss important scientific work. But I am consoled by the thought that if each of these minority language areas keeps to its own language in both reading and writing, then the likelihood of my missing much of consequence is not too great. Would Dr. Lincicome allow us abstracts and perhaps table headings in a language that 10% of the world's scientists can read?

Dr. Lincicome proposes Esperanto, and I should most heartily welcome it *if* there is any prospect at all for its use. After all, the whole question of communication resolves itself into the communication and those who receive it. With Polish very few physiol-

ogists (and other scientists) can receive the communication. With Esperanto the same is at present true, with the additional limitation that no communications are being offered. But I should be willing to join my colleagues in any generally attempted solution, even if it means sitting up nights with an Urdu grammar or a Quechuan wordbook.

ANCEL KEYS

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The Hemolytic Substance Present in Animal Tissues

TYLER (*1*) has recently reported hemolytic activity in saline extracts of fetal and adult guinea pig liver. The lytic activity varied in different fractions of the extracts, which were obtained by centrifugation at 2,500 rpm and at 25,000 and 100,000 × *g*; there were also relative differences between adult and fetal extracts. This was taken as "substantial evidence" of differences in the rate of enzymatic (hemolytic) activity between fetus and adult, which were considered not to be due to differences in enzyme concentrations but in inhibitor.

Tyler makes the following statements and suggests alternative theories concerning the nature and mode of action of the hemolytic substance present in animal tissues:

1. An unidentified hemolytic agent occurs in normal and pathological tissues.

2. Plasma or serum and possibly brain contain inhibitory substances of the hemolytic agent, which are thus far undefined.

3. Practically no attention has hitherto been paid to intracellular inhibitors of hemolysis.

4. The lytic agent is an enzyme acting directly on the cell membrane, which is its substrate, with inactivation resulting from the ability of inhibitors to act as competitive substrates; or

5. The lytic agent is enzymatically produced, with inhibition taking place through the formation of an inhibitor-lysin complex.

The following facts (*2–7*) refer to each of the above-mentioned points:

1. The hemolytic substance present in plasma and animal tissues has been isolated in crystalline form (*2*) and identified as *cis*-vaccenic acid [$CH_3 \cdot (CH_2)_5 \cdot CH{=}CH \cdot (CH_2)_9 \cdot COOH$] (*3*).

2. The inhibitors of hemolysis present in plasma are albumin globulin, calcium, cholesterol, and lecithin. Their quantitative interrelationship with the hemolytic acid has been examined. Phosphate and, in pathological conditions, hematin and porphyrins act as accelerators. Extraneous circulating hemolytic acid has no effect on erythrocytes under normal conditions because of a large excess of inhibitors in the plasma. It may, however, be a contributory factor to hemolysis in certain pathological conditions, as, e.g., in blackwater fever (*4*).

3. Normal erythrocytes contain the hemolytic acid, which is most likely related to their normal life span. Hemoglobin and stromatin act as powerful *intracellular* (intracorpuscular) inhibitors of lysis during most of the life of the normal erythrocyte. Only in aging erythrocytes does the hemolytic acid seem to become dissociated from its complex with stromatin.

4. No experimental evidence exists for the contention that the body contains a hemolytic enzyme, whose substrate is the cell membrane. As this is a lipoprotein, it can only be acted upon through one of its constituents. The supposition that the enzyme is proteolytic can be excluded. It could therefore be solely concerned with the degradation of the lipid component, as was first suggested by Bergenehm and Fahraeus (*9*). However, the claim advanced by these authors in favor of the existence of (hemolytic) lysolecithin produced from lecithin by an enzyme (i.e., lecithinase) was not supported by direct experimental proof—as, for instance, isolation of either the enzyme or the lysolecithin—but was based on indirect evidence and analogies. These have not stood the test of critical reexamination. Their claim must therefore be abandoned.

5. The claim that the hemolytic agent, though not an enzyme, is enzymatically produced, may be made for innumerable substances that are not ingested but changed or synthesized by the body.

As the structure of the hemolytic acid present in animal tissues is now established, there seems to be no need of further speculation regarding its nature.

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Professorships in Foreign Countries

OPPORTUNITIES for foreign exchange professorships and visiting professorships are plentiful. The Fulbright Exchange Program is expanding; the Smith-Mundt Act provides for visiting professorships; teaching opportunities exist in the American Military Governments of Japan and Germany; and many positions are available through the Unesco fellowships, scholarships, and educational exchange programs. My experience in this type of work began in 1946–47 when, as consultant in biology for AMG in Korea, I had the opportunity to teach in several Korean colleges and universities (*Science*, **107**, 31, [1948]). In June 1950 I was visiting professor of parasitology at Seoul National University Medical School. In Japan, after the evacuation, I discussed at length the experiences, impressions, and conclusions of several others who taught in Korea. Combining their ideas and mine, I here present some general reactions and recommendations with the hope they will help anyone who plans to accept a foreign professorship.

An interpreter is usually required. This means that less than half as much material can be presented during each lecture as one is accustomed to give, especially as it is necessary to speak slowly and repeat often. I found it a great help to write out all introductory remarks before each lecture and to give them to the interpreter to study. He was fairly good with technical material, for it was in his own field of specialization, but he was very poor at translating informal remarks.

Reliance on formal lectures alone has been a traditional practice in Korea. Laboratories were seldom used. The American visiting professor of chemistry was asked to give two sections each of 5 lectures in inorganic chemistry, 5 in organic chemistry, and 5 in biochemistry, and to handle a seminar. In addition, he was supposed to supervise the laboratories that he insisted on scheduling. He finally was able to reduce the lectures to a total of 12 per week, which was still too heavy a load for efficient teaching. It would be wise to have an agreement in writing concerning teaching load before accepting such a position.

Textbooks, laboratory manuals, mimeographed material, drawing paper, and even pencils were scarce in Korea. I took with me enough stencils for my work. Almost all Korean students are able to study something written in English, as long as they have sufficient time and a dictionary. My students begged me to give them complete lectures mimeographed in English word for word as I would give them orally. I suspect that the request reflected a desire to practice English. I mimeographed a complete outline of each lecture, which I gave out several days in advance. In one class of 60 students only 6 had textbooks, none had a laboratory manual. I wished I had brought more sample manuals, charts, and other teaching aids.

Grading was a problem. In 1947 I turned that job over to my assistants, since most of the answers to questions were in Korean. I helped in making out examination questions and in setting up identification examinations in the laboratory. I tried to explain systems of grading used in this country. I have reason to believe, however, that the only students to fail were those who had the wrong political faith. In 1947 the students I talked to had never heard of an objective-type examination. By 1950 many had taken true-false quizzes. Whether this was progress depends on the point of view.

Equipment was spotty. It is well to anticipate a minimum of laboratory or lecture-demonstration equipment. We had good Japanese microscopes and a few good slides. We could have used many more slides, staining fluids, and glassware. We had no microscope lamps and only one centrifuge. If at all possible, one should take equipment and supplies with him; some of the grants for professorships include funds for this purpose. Library facilities cannot be depended upon. It is advisable to take the most needed of one's own reference books. (The Communists got a dozen of mine!)

Understanding of, and sympathy with, the Korean people are of fundamental importance to success in that country. I believe that the visiting professors, as a group, were well prepared in this respect. Unfortunately, many of the other Americans were not. It was astonishing to find so many Americans who came to Korea with practically no knowledge of the country or its people—not even the knowledge that could be gathered from a rapid reading of an appropriate page or two in an encyclopedia. What is much worse, these people did not care to learn anything about Korea. Every American abroad represents our country. We must not forget it. It is especially important in an Oriental country. A native student has a tendency to believe that all Americans are like his American professor. The only way a visiting professor can keep faith with those at home is to show by his words and conduct that he has a genuine liking for the native people and that he has taken the trouble to learn something about their country, their habits, their language, and their philosophies and ideals. If he does not do this, he is not the man for the job.

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The Rectangular Earth

IN THE discussion entitled "The Bible and the Earth's Shape," by Carl S. Wise (*Science*, **113**, 128 [1951]), Mr. Wise left out the one verse in the Bible that probably caused all the comment. This verse is in Rev. 7: 1 and reads as follows: "And after these things I saw four angels standing on the four corners of the earth, holding the four winds of the earth, that the wind should not blow on the earth, nor on the sea, nor on any tree."

It is quite evident that the description above is not that of a sphere, or of anything round, or of a cube, but that of a rectangle. Since it would fit only one form, that of a flat area with four corners, the inference is that the earth was believed to be like a rectangular-shaped pancake.

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Robert D. Wright, professor of social and environmental medicine at the University of Virginia, has been awarded a fellowship by WHO to study social medicine and human ecology in Europe.

Recent visitors at the National Bureau of Standards were **Arthur Fage**, superintendent of the aerodynamics division of the National Physical Laboratory, Teddington, Eng.; **Percy Tham**, director, Photogrammetric Division, Royal Geographic Survey Office, Stockholm; **H. U. Dutsch**, physicist, Lichtklimatisches Observatorium Arosa, Zurich; and **Gustave Guanella**, chief engineer, Brown Boveri Co., Baden, Switzerland.

Book Reviews

The Population of India and Pakistan. Kingsley Davis. Princeton, N. J.: Princeton Univ. Press, 1951. 236 pp. $7.50.

This book is the fifth of a series of population studies undertaken by the Office of Population Research of Princeton University with which Dr. Davis was formerly associated. It gives us, first of all, an excellent picture of the population of India and Pakistan. It is rich in maps, tables, and figures from which one may quickly grasp the quantitative data. One soon recognizes how thoroughly the censuses have been studied and the competent and imaginative handling of the figures. The lazy method of some writers who combine conflicting data in the same table, with a mere footnote warning to the reader, does not appear here; the author himself has carefully produced those adjustments of figures necessitated by changes in census procedures, by the separation of Burma from India, and by the partition into the Indian Union and Pakistan. By the device of an oversize volume, figures, maps, and tables have adequate space for inclusiveness and clarity.

But the population picture is not primarily quantitative. The text adds meaning to the statistics by way of historical background and cultural interpretations and implications. Indeed, the second half of the book is concerned directly with "social structure and social change," including an application of demography to urbanization, education, caste, and religion, a discussion of the recent partition, and finally an appraisal of economic achievement and a suggested population policy. In fact, the volume centers not merely on the "population" but on the "population problem" of India and Pakistan.

Davis sees this problem somewhat as follows. The outstanding fact is poverty, and the primary goal is a greater per capita real income. It is too simple to say that this goal can be achieved through industrialization. As a result of developments usually accompanying modern industry, but lagging in India, "population growth has become a Frankenstein" and agriculture an insecure base for further industrialization. In order to avoid "disastrous growth of population or a calamitous rise in the death rate" a decline in fertility is necessary. Such a decline is not predicted as a normal development in the immediate future. It must be achieved through conscious policy. Not only will a crowded population on the eve of industrialization impede industrial development, but the final level of income may be affected, as it seems possible "that the real income in industrial countries is strongly influenced by the point at which demographic growth is stabilized with reference to resources."

A lower birth rate—the only practical means of slowing down the rate of population growth—can be achieved through birth control or rapid industrialization. The author recommends both, but believes that the former is actually easier to achieve than the latter, because "a program of forced industrialization would violate far more taboos and arouse more resistance than would the dissemination of birth control education and propaganda." The likelihood is that the current policy and program of industrialization in Pakistan and the Indian Union will not sufficiently emphasize those very elements which would depress fertility, namely, education, urbanization, mobility, multifamily dwellings, and conspicuous consumption.

Thus Dr. Davis does not hesitate to give us the benefit of his advice, and thereby makes his book more interesting and useful. This is true not only of the main subject but also of incidental matters. For example, on page 13, he draws this conclusion: "The partition of India need not have happened, because the geographical and cultural basis for a single united India was present." And on page 200 he says that Pakistan and India might "adopt the mistaken view that military efficiency would be increased by an expansion of numbers."

Mention must be made, finally, of the good bibliography, which is topically arranged.

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The British Smut Fungi (Ustilaginales). G. C. Ainsworth and Kathleen Sampson. Kew, Surrey, England: Commonwealth Mycological Institute, 1950. 137 pp. $3.00.

This is the first general biological and systematic account of British smuts since Plowright's 1889 *Monograph of the British Uredineae and Ustilagineae.* The book includes a description of 74 species of British smuts, involving 14 genera. The descriptions are based on the smut collections in the British national herbariums and on critical review of published materials. The authors give a key to genera but not to the species. With the exception of *Ustilago* the species are arranged under the generic name in alphabetic order. In *Ustilago* the species are grouped on the basis of size and markings of chlamydospores.

Along with morphological description of the species, there are short concise accounts on germination of spores, infection of host, and racial specialization for many of the important species. In addition there are many sketches of the chlamydospores and their mode of germination.

The authors do not propose any new species, but new combinations are used. Thus *Ustilago nuda* includes *U. tritici, U. kolleri* is combined with *U. hordei,* and *U. nigra* is designated as *U. avenae* f. *nigra.*

Thirty-seven pages of the text are devoted to brief accounts of biology, cytology, genetics, techniques, and classification. These are presented in an interesting and concise manner, and are indeed informative

and stimulating to students working either in the field of mycology or plant pathology. One is impressed by the authors' thorough familiarity with their subject matter.

The text is followed by an extended bibliography of more than 600 references and an index to generic and specific names of smuts and to the British hosts. Although the systematic material presented is limited to the smuts found in the British Isles, it will be a valuable and useful book to students elsewhere.

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Theory of Mental Tests. Harold Gulliksen. New York: Wiley; London: Chapman & Hall, 1950. 486 pp. $6.00.

In this book Professor Gulliksen has brought together and "distill'd to the sweet substance of pellucid thought" an enormous amount of journal literature covering more than half a century, not all of which was notable for its original lucidity. In this book he has, moreover, contributed notably to the thinking that, in spite of many unsolved problems of analysis, has provided a rational, scientific foundation for much of psychology in general, and test theory in particular. It is a major contribution in a rapidly developing area of psychology that no advanced student of the science of psychology can afford to ignore, especially if he is interested in applications to human engineering. While developing test theory, the author continually keeps in mind the practical human purposes to be served by tests.

The book consists of 21 chapters, with headings ranging from "Basic Equations Derived from a Definition of Random Error" to "Problems of Weighting and Differential Prediction" and "Item Analysis." There are also four useful appendices. Each chapter develops its theme with clearness and economy.

This volume will doubtless become a standard textbook for advanced courses in test theory and technology. Commendable aspects of the volume include the many labor-saving computational diagrams and short-cuts; concise section and chapter summaries; excellent sets of problems and exercises at the end of each chapter; an appendix giving the equations from algebra, analytical geometry, and statistics used in developing the theory of tests; a table of ordinates and areas of the normal curve; 10 pages of searching "Sample Examination Questions for Use as a Review Examination at the Beginning of the Course in Test Theory;" 14 equally searching pages of "Sample Examination Items in Test Theory;" 24 pages of bibliography (this reviewer counted 535 titles); an author index; and an adequate topic index.

The average liberal arts undergraduate in this country, with no more mathematics than he typically gets, will find it necessary to learn more mathematics or to leave as incomprehensible certain sections and chapters that require, in addition to algebra, statistics, and analytical geometry, some knowledge of curve fitting, matrix theory, and the use of determinants. If he has mastered the requisite mathematics, however, the student and the research worker will find this book a convenient and powerful new tool.

The fashion in book reviewing appears to require some critical comments. Concerning a work of such excellence such comments could hardly be more than carping criticisms. Nevertheless, not even Gulliksen's enormous and thorough scholarship can avoid occasional minor lapses. When, in discussing methods of scoring tests, he points out that personality factors of testees may influence their skipping or failing to attempt items, and says (p. 246) "No one seems to have investigated such possibilities," he overstates the case. There have been a very few such studies, and such personality factors have been found to operate.

All professional workers concerned with tests and testing owe Professor Gulliksen a debt of gratitude for having written, so far as this reviewer is aware, the best book of its kind available and a landmark in a rapidly growing complex area of science—clearly written, eminently teachable as a text, and invaluable as a reference work on the rationale of mental testing. Moreover, he suggests many problems that further investigation, both analytically and experimentally.

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Scientific Book Register

Somatic Development of Adolescent Boys: A Study of the Growth of Boys during the Second Decade of Life. Herbert Rowell Stolz and Lois Meek Stolz. New York: Macmillan, 1951. 557 pp. $9.00.

Pertubation Methods in the Quantum Mechanics of n-Electron Systems. E. M. Corson. New York: Hafner, 1950. 308 pp. $11.00.

Hyperbrachycephaly as Influenced by Cultural Conditioning. J. Franklin Ewing. Cambridge, Mass.: Peabody Museum of American Archaeology and Ethnology, Harvard University, 1950. 99 pp. $3.75.

Researches in Binocular Vision. Kenneth N. Ogle. Philadelphia-London: Saunders, 1950. 345 pp. $7.50.

The Computation of Elements of Eclipsing Binary Systems. Zdeněk Kopal. Cambridge, Mass.: Harvard College Observatory, 1950. 181 pp.

Technique of Organic Chemistry: Distillation, Vol. IV. Arnold Weissberger, Ed. New York-London: Interscience, 1951. 668 pp. $14.00.

Radioactive Tracers in Biology: An Introduction to Tracer Methodology. 2nd ed. Martin D. Kamen. New York: Academic Press, 1951. 429 pp. $7.50.

The Water and the Power: Development of the Five Great Rivers of the West. Albert N. Williams. New York: Duell, Sloan & Pearce, 1951. 378 pp. $4.50.

Le Sostanze Cancerigene: Costituzione e Ipotesi sul Meccanismo d'Azione. Maria Prato and Giorgio Nebbia. Città di Castello, Italy: Soc. Tip. Editrice "Leonardo da Vinci," 1950. 151 pp.

News and Notes

Scientists in the News

Percival Bailey has been appointed director of the Illinois Neuropsychiatric Institute, Chicago, but will continue to serve in his joint position as distinguished professor of neurology and neurological surgery at the University of Illinois College of Medicine and as research consultant for the Illinois state mental hospitals. The Illinois Neuropsychiatric Institute is a research and educational facility maintained by the State Department of Public Welfare. The medical staff is provided by the University of Illinois College of Medicine.

Oliver A. Bauman, Jr., biological products specialist, has left for India as a representative of the USDA to advise India's Ministry of Agriculture on the production of animal vaccines and serums. Mr. Bauman's work will center at the Indian Veterinary Research Institutes at Izatnagar and Mukteswar, United Provinces. In India he will join other department employees already there on Point IV agricultural assignments: **Horace C. Holmes,** agricultural adviser; **Earle K. Rambo,** agricultural engineer; and **Ford M. Milam,** agronomist.

Charles L. Brown, of the Hahnemann Medical College, was the recipient of the Strittmatter Award for 1951, from The Philadelphia County Medical Society. This award is presented each year to the "physician who has made the most valuable contribution to the healing arts or who has contributed extraordinary meritorious service to the medical profession."

George Granger Brown has been appointed dean of the College of Engineering at the University of Michigan. Dr. Brown, who has been on the faculty since 1920, will succeed **Ivan C. Crawford,** who will retire from the deanship to return to private practice as a consulting engineer.

Marshall Brucer, chairman, and **Herbert D. Kerman,** radiologist, of the Oak Ridge Institute Medical Division, have been in Canada for conferences concerning the telecobalt therapy unit now being irradiated in the Chalk River reactor for testing by the Medical Division and the M. D. Anderson Hospital for Cancer Research. In addition to visiting officials of the National Research Council of Canada and the El Dorado Mining Company, Drs. Brucer and Kerman conferred with physicists at the University of Saskatchewan, which is also building a telecobalt therapy unit.

Marion T. Clark, assistant professor of chemistry at Emory University, has joined the Oak Ridge Institute of Nuclear Studies as assistant to the chairman of the University Relations Division. Dr. Clark will be concerned with the administration of university participation in the atomic energy program.

Charles G. Dobrovolny, senior scientist, Laboratory of Tropical Diseases, National Institutes of Health, has been ordered to Recife, to cooperate with the Pan American Sanitary Bureau and the National Health Department of Brazil on field trials of molluscacides effective against the snail hosts of the parasites causing schistosomiasis. His headquarters will be at Instituto Aggeu Magalhaes in Recife.

Malcolm Dole, Northwestern University chemistry professor, is in South America collecting air samples for an Army Air Force research project on long-range weather forecasting. When he returns to Northwestern, Dr. Dole and **DeForest P. Rudd** will analyze the samples to detect any variation in the atomic structure of the oxygen in the South American air. Regional variations may provide information pertaining to the movement of air currents that would be important to long-range weather forecasting.

Lee A. DuBridge, president of Caltech, has accepted the invitation of Dwight D. Eisenhower to serve as a member of the new National Manpower Council established at Columbia University. Named by President Truman to membership on the Science Advisory Committee of the Office of Defense Mobilization, he is also a member of the Scientific Manpower Advisory Committee of the National Security Resources Board. The aim of the Columbia University council is to appraise the nation's manpower resources "in a period of enduring emergency." Specific objectives of the council, which is financed by a $100,000 grant from the Ford Foundation, are to identify and evaluate the major areas where significant manpower wastes now occur; to determine methods for improving present use of the nation's manpower; and to make recommendations for developing unused potentials of existing manpower resources.

R. Adams Dutcher, head of the Department of Agricultural and Biological Chemistry, and chairman of the Council on Research at Pennsylvania State College, will retire July 1 to devote full time to technical writing and consultation work on foods and nutrition. He has served as head of the department since 1921.

George Shannon Forbes, professor emeritus of Harvard University, has been chosen to receive the $1,000 James Flack Norris Award, in recognition of his 44 years of distinguished service as a chemistry teacher, mostly at Harvard, where he became chairman of the Department of Chemistry in 1944. Dr. Forbes also served as an associate in chemistry at Bryn Mawr and at Radcliffe, and since his retirement from Harvard he has been teaching at Northeastern. This is the first presentation of the Norris Award, which will be conferred upon outstanding teachers in schools, colleges, and universities by the Northeastern Section in memory of Professor Norris, authority on organic chemistry and himself a renowned teacher, who was twice

president of the American Chemical Society, and director of the research laboratory of MIT from 1926 until his death in 1940. The award will be presented every second year, alternating with the section's Theodore William Richards Medal for achievement in research.

Nine aides of the Rockefeller Foundation have received the French Legion of Honor in recognition of the foundation's work in France. **Raymond Fosdick,** former president of the foundation, was made a Grand Officer of the Legion of Honor, and **George K. Strode,** director of the international health division, was made a Commander. **Chester I. Barnard,** Foundation president, **Warren Weaver, Alan Gregg,** and **Walter Stewart** became Officers, and **Andrew J. Warren, John Marshall,** and **Harry Miller** received the Cross of Chevalier.

Arthur B. Lamb, emeritus professor of chemistry at Harvard and editor for 32 years of the *Journal of the American Chemical Society,* was chosen to receive the 1951 Austin M. Patterson Award in the Documentation of Chemistry, sponsored by the Dayton Section. An illuminated, hand-engraved scroll, testifying to his long years of service to chemistry and the chemical profession, was presented to Dr. Lamb. Dr. Patterson, retired vice president of Antioch College, first winner of the award that now bears his name, spoke on the editorial achievements of Dr. Lamb. Other speakers were E. J. Crane, editor of *Chemical Abstracts,* and Richard G. Yalman, assistant professor of chemistry in Antioch College.

On May 5 the chemists of the Southeastern states met in Milledgeville, Ga., for the annual celebration of Herty Day and the awarding of the Herty Medal, which honors Charles Holmes Herty, twice president of the American Chemical Society. **James Tucker MacKenzie,** technical director of the American Cast Iron Pipe Co., Birmingham, Ala., received the 1951 medal, for his research in metals.

Ethel Austin Martin is retiring as director of the Department of Nutrition Service of the National Dairy Council. She plans to continue active in the field of nutrition and has agreed to serve as a special consultant to Milton Hult, NDC president. Under Mrs. Martin's guidance, the Department of Nutrition Service began functioning as two separate departments on February 1, with **Elizabeth Beyer** directing a Department of Materials Development Service, and **Zoe Anderson** a Department of Research and Nutrition Service.

Fuller Nance, B & O medical and surgical director, recently retired. He was engaged in private practice before going to the B & O in 1917 as assistant medical examiner. In 1945 he was named medical and surgical director, succeeding the late Edward V. Milholland. Dr. Nance served as B & O member of the Medical and Surgical Section of the American Railroads, Committee of Direction, and as member of the Joint Committee on Railway Sanitation of the Association of American Railroads.

Emerson Venable has opened consulting offices and a laboratory in Pittsburgh, for chemistry and engineering. For the past five years he has been director of research of Freedom-Valvoline Oil Company. Mr. Venable has served the Westinghouse Electric Company and the Mine Safety Appliances Company in various research capacities and is the inventor of gas mask improvements widely used by the armed services.

Colleges and Universities

The **University of Chicago** opened its new $5,000,000 Research Institutes Building with informal dedication ceremonies on May 16. The Institute for Nuclear Studies and the Institute of Radiobiology are two of the three groups that will use the building. These two and the Institute for the Study of Metals will be concerned with basic research in the development of new knowledge entirely in the field of nonsecret, peacetime activities. About one third of the $2,000,000 annual research budget is provided by 26 industrial firms, and three Nobel prize winners, as well as many other leading scientists, comprise the staff of 100-odd. The university's medical research center is also planning to expand, by the addition of clinical facilities to cost $4,500,000. One of the new hospitals will be the Charles Gilman Smith, to be used for research and treatment of contagious and heart diseases. The second will do work in orthopedics and in chronic diseases, including tuberculosis, allergy, arthritis, and metabolic disorders. Funds were provided through FSA, the Hill-Burton Fund, University of Chicago Council on Medical and Biological Research, and a bequest from the late Dr. Smith.

Illinois Institute of Technology has entered into a joint program with **Illinois College,** for study leading to degrees in both liberal arts and engineering. Students will attend Illinois for three years and Illinois Tech two, receiving a B.A. from the college and a B.S. from the technical school. This program is similar to those in effect at Westminster, Washington and Jefferson, Roosevelt, and Aurora College.

Starting June 25, the **University of Illinois** Chicago Professional Colleges will offer an eight weeks' summer course for bacteriologists interested in laboratory experience in basic techniques in virology. Full graduate credit will be given. Applications and requests for information should be addressed to Milan V. Novak, 808 S. Wood St., Chicago 12.

Beginning with the 1951–52 academic year, **New York University's** Washington Square College of Arts and Science will adopt a new educational program that will endeavor to give the student an adequate knowledge of the physical forces determining man's environment and familiarize him with the continuing traditions and dominant problems of his culture. This is expected to be accomplished by giving integrated courses in such subjects as men and ideas in Western civilization, the literary heritage of Western culture, and principles of effective thinking, along with courses in the natural and social sciences.

Changes in name of three **University of Wisconsin** departments have been approved by the Board of Regents. The Department of Dairy Industry becomes the Department of Dairy and Food Industry, the Department of Agricultural Bacteriology becomes the Department of Bacteriology, and the Department of Economic Entomology becomes the Department of Entomology.

North Carolina State will make available this summer for the first time, from June 11 to August 11, a full-time graduate program in the fields of ceramic, chemical, and electrical engineering, with supporting courses in mathematics and physics.

The following training centers have scheduled short courses in the **treatment of poliomyelitis** patients:

	Physicians	Nurses
Children's Medical Center, Boston	June 4–8. Aug. 6–10.	One month starting July 9 and Sept. 24.
D. T. Watson School of Physiatrics, Leetsdale, Pa.	6-day courses—dates to be arranged according to number and time of applications.	Dates to be specially arranged. Emphasis placed on respirator care and use of the rocking bed.
Georgia Warm Springs Foundation, Warm Springs	1-week course—starting first week in July and Oct.	
Orthopaedic Hospital, Los Angeles	May 21–24. Oct. 22–25.	May 21–25. Oct. 22–26.
Stanford University School of Medicine, San Francisco	1 course scheduled in the summer—probably in June.	
University of Colorado Medical Center, Denver	May 7–9, poliomyelitis. Dec. 13–15, postgraduate course in poliomyelitis in conjunction with other pediatric problems.	June 18–July 6.

Enrollment must be arranged directly with the training center. Physicians and nurses who need financial assistance to attend the courses should get in touch with their local chapters of the National Foundation for Infantile Paralysis.

The **University of Tennessee** will open its new anatomy building during the June commencement. It will be named for August Hermsmeier Wittenborg, who joined the staff as an instructor in physiology in 1911, finally becoming chief of the Divsion of Anatomy in 1925. Dr. Wittenborg died in Ann Arbor, Mich., in 1941.

Temple University held its eighth annual Reading Institute January 29–February 2, with delegates from 30 states, Canada, and New Zealand. The sequence of language development and the relation of reading instruction to this sequence were emphasized in lectures and laboratory sessions. "Prevention and Correction of Reading Difficulties" will be the theme of the next institute, which will be held January 28–February 1, 1952. Interested persons should write to Emmett A. Betts, The Reading Clinic, Temple University, Philadelphia 22.

Grants and Fellowships

Columbia, Harvard, Princeton, and Yale will share equally in a fund of $1,000,000 to be distributed by the **Eugene Higgins Scientific Trust** for scientific education and research during 1951–52. Columbia will apply the funds to continuation of work on nuclear, atomic, and molecular physics; Harvard, to education and research in medicine and dental medicine; Princeton, mainly to biology, geology, engineering, mathematics, and physics. Yale will use the funds for chemistry and the medical sciences.

Bio Sciences Group, **Office of Naval Research,** has completed contract negotiations on the following projects: Research in the Field of Distribution and Identity of Yeasts on Normal Skin in Relation to Blastomycotic Infections, C. E. Skinner, State College of Washington; Physical Methods of Virus Inactivation, E. C. Pollard, Yale; Artificial Respiration, Peter V. Karpovich, Springfield College; Investigations into the Processes of Protein Synthesis and Degradation in Living Bacteria, Gerrit Toennies, Institute for Cancer Research; and Studies on Plasma Substitute, Joan Humphrey-Long, Temple University.

The **Fund for Adult Education,** recently organized by the Ford Foundation, has given $90,000 for the work of the Joint Committee on Educational Television, which is composed of representatives of the American Council on Education, Association for Education by Radio, Association of Land-Grant Colleges and Universities, National Association of Educational Broadcasters, National Association of State Universities, National Council of Chief State School Officers, and the National Education Association. Objective of the committee is to represent the interests of educational television in utilization of frequencies reserved for that purpose by the FCC, and otherwise to assist educational institutions to establish and operate stations. Edgar Fuller, of the State School Officers, is chairman, and headquarters are at 1785 Massachusetts Ave., N.W., Washington 6, D. C.

The **U. S. Public Health Service** has approved grants totaling $1,054,967 to 82 institutions in 33 states, the District of Columbia, and two foreign countries. Largest sum went to Edwin J. Cohn and Charles A. Janeway, Harvard, for blood investigations. Substantial allocations also were made to George Sayers, University of Utah, for research in cortisone and related steroids; to Gregory Schwartsman, Mount Sinai Hospital, New York, for work on vitamins and adrenal cortical function; James M. Winfield and Charles L. Fox, New York Medical College, for study of the treatment of shock from burn injury; and to Alberto Hurtado, University of San Marcos, for evaluation of saline therapy and ACTH in burns and shock.

The **National Fund for Medical Education,** sponsored by industry, the medical profession, organized labor, agriculture, university presidents, and twelve

scientific and educational foundations, has been organized to give financial assistance to U. S. medical schools. Its initial resources amount to $1,000,000. The American Medical Educational Foundation, organized last December by the AMA for the same purpose, will channel its contributions from doctors through the new foundation. Herbert Hoover is honorary chairman of the fund; other officers are S. Sloan Colt, of Bankers Trust Company, president; Samuel D. Leidesdorf, treasurer; William E. Cotter, secretary; and Chase Mellen, Jr., executive director. Sixty-two representatives of the sponsoring organizations form the board of trustees.

The **Office of Naval Research** has made a grant of $35,000 to the School of Dentistry of the University of Pennsylvania for research on the prevention or cure of oral lesions produced by the use of radioactive materials. Work will be done under the direction of Paul E. Boyle, professor and chairman of the Department of Oral Histology and Pathology, in collaboration with the Naval Medical Research Institute. As a result of the shortage of trained technicians, the university has instituted a training program to be devoted solely to studies of the histological effects of ionizing radiation upon oral tissues, a course which may eventually be considerably extended. Six students per year will be trained, and those with some college education are preferred.

In the Laboratories

Armour & Company will soon open a new plant in Buenos Aires, to tap new sources of raw material to supply insulin, ACTH, and trypsin. The building will be equipped with machinery from the U. S., and the staff will include a nucleus of North Americans to train Argentine personnel who will eventually operate the establishment. It is estimated that about 20% of the potential capacity of the drugs will be required to fill the needs of Argentina; the Argentine government has agreed to export of the surplus. S. B. Bradshaw, manager of the international department of Armour, will be president of the new subsidiary, Laboratorios Armour de Argentina, S.A., and Loyal C. Maxwell and J. G. Speer, vice president and secretary-treasurer, respectively.

Dacron, **Du Pont's** new polyester fiber (formerly Fiber V and "Amilar") will be manufactured at a new plant to be built this spring on a 635-acre tract on the Neuse River, near Kinston, N. C. Carroll S. Anderson will be field project manager.

Sharp & Dohme (Philippines), Inc., is constructing a new, modern building in Manila, expected to be ready for occupancy this summer. Partly air-conditioned, it will include a conference room for the use of medical and government groups, as well as company personnel. Sharp & Dohme is at present manufacturing all products sold in the Philippines in the U. S. The export expansion will help the dollar exchange shortage in the Islands and help in diversification of industry.

Meetings and Elections

The **American Academy of Arts and Sciences** has elected Edwin H. Land president, succeeding Howard Mumford Jones. Elected vice presidents were: Class I (mathematical and physical sciences), Jerome C. Hunsaker; Class II (natural and physiological sciences), Alfred S. Romer, Harvard; Class III (social arts), Edwin D. Canham, editor, *Christian Science Monitor*; and Class IV (humanities), Wallace Goodrich, New England Conservatory of Music. Fifty-eight new Fellows and five Foreign Honorary Members were elected, bringing the total membership near the permissible limit of 1,000.

The Central States Section of the **Botanical Society of America** will hold a June foray in the Ozark Hills June 14–17, which will include tours of the herbarium, laboratories, and arboretum of the Missouri Botanical Garden, and trips to Ironton, Johnson Shaut-in, Big Spring State Park, Round Spring, Juniper Ridge, and Washington State Park. The foray, annual business meeting, and election of officers will be under the direction of Julian Steyermark and Robert W. Schrey. Inquiries as to reservations and for information should be addressed to G. W. Prescott, Michigan State College, East Lansing, before *June 4*.

A Conference on Influence of Hormones on Enzymes will be held at the New York Academy of Sciences June 5–6, at which attendance will be limited to those invited to participate and to interested members of the Academy. Ralph I. Dorfman is conference chairman, and Gregory Pincus session chairman. C. D. Kochakian, W. H. Fishman, S. L. Cohen, W. W. Umbreit, R. M. Hochster, and C. F. Cori, among others, will participate in the discussions.

Officers elected for 1951–52 at the spring business meeting of the **National Association of Science Writers**, held in Washington, D. C., April 24, were: Marguerite Clark, *Newsweek*, president; Volta Torrey, *Popular Science Monthly*, vice president; and Alton L. Blakeslee, Associated Press, secretary-treasurer.

The **West Virginia Academy of Science** held its 26th annual meeting at Marshall College, Huntington, April 27–28. N. Bayard Green was elected president; B. G. Anderson, vice president; E. E. Myers, secretary; and James L. Hall, treasurer.

At the Philadelphia meeting of the AAAS, December 26–31, **Section G (Botanical Sciences)** will present a series of symposia of general interest, with the cosponsorship of several societies. In addition, the section will schedule as many sessions for individual contributed papers as the demand of authors requires. To aid in arranging these sessions, prospective participants should notify the section secretary at the earliest possible date. Please send titles and other pertinent information to Stanley A. Cain, School of Natural Resources, University of Michigan, Ann Arbor. They will be acceptable at any time until the deadline early in the fall.

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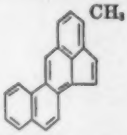

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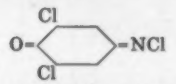

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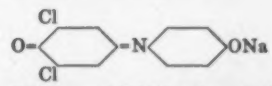

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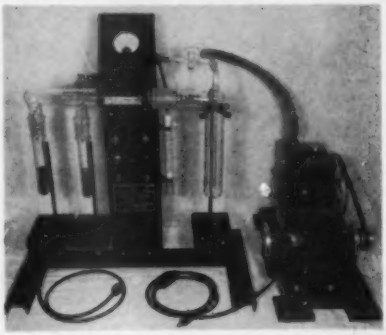

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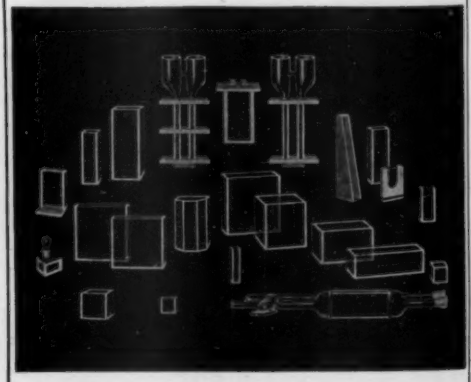

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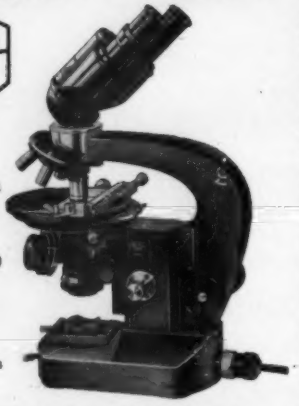

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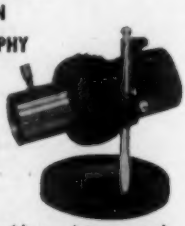

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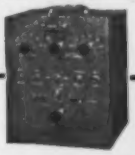

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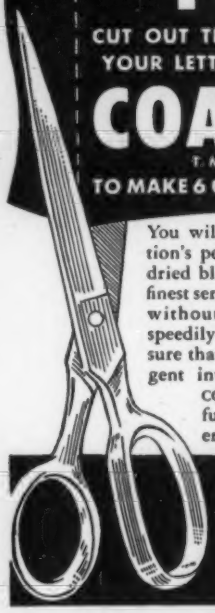

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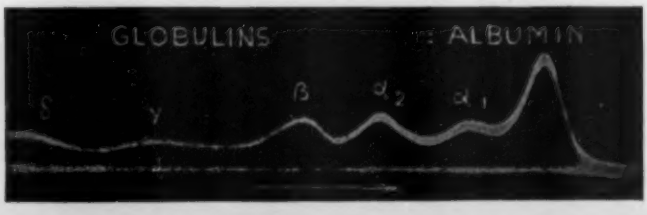

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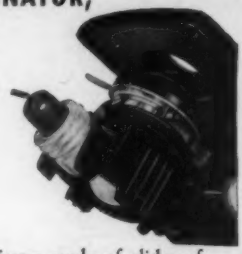

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